Template

November 14, 2019

$\operatorname{GummyBear}$

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.vimrc

```
void init() { memset(f, -1, sizeof(f)); }
                                                       while(x) dig[pos++] = \times \% 10, \times /= 10;
                                                                                       return dfs(pos -1, ..., 1);
                                                                                                                                                                                                    init();
// 可调用 solve(x) 多次
11 solve(11 x) {
                             int pos = 0;
                                                                                                                                                                       void solve()
                                                                                                                                          nmap<F9> : :w <CR> :!g++ % -0 %< -02 -g -std=c++11 -wall <CR>
                             sts=2 sw=2
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                             set nu ai ci si mouse=a ts=2
                                                       nmap<F2> : vs %<.in <CR>
                                                                                    nmap<F3> : !gedit % <CR>
```

if (!lim) f[] = res;

return res;

DataStructure

3

2DST

#define rep(i, a, b) for(int i=(a); i<(b); i++) #define per(i, a, b) for(int i=(b)-1; i>=(a); i--)

#define pb push_back

#**define** mp make_pair

#define se second #define fi first

#include<bits/stdc++.h>

Head

1.2

using namespace std;

#define de(a) cout << #a << " = " << a << endl #define dd(a) cout << #a << " = " << a << " "

#define sz(a) (int)a.size()

#define all(a) a.begin(), a.end()

#define pw(x) (111<<(x))

#define endl "\n"

typedef pair<int, int> pii;

typedef vector<int> vi; typedef long long ll;

typedef double db;

int main() {

```
rep(i, 1, dep1+1) rep(j, p[i], n+1) rep(k, 0, dep2+1) rep(l, p[k], m+1) st[i][k][j][l]=max(st[i-1][k][j-p[i-1]][l]], st[i-1][k][j][l]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int l1 = Log[x2-x1+1], l2 = Log[y2-y1+1];
int res1 = max(st[l1][l2][x1+p[l1]-1][y1+p[l2]-1], st[l1][l2][x2][y2]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int res2 = max(st[l1][l2][x1+p[l1]-1][y2], st[l1][l2][x2][y1+p[l2]-1]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                   rep(i, 1, n + 1) rep(j, 1, dep2 + 1) rep(k, p[j], m + 1) st[0][j][i][k] = max(st[0][j-1][i][k], st[0][j-1][i][k - p[j-1]]);
                                                                                                                                                                                                                                                                                for(dep1 = 0; (1 << dep1) < n; dep1++);
                                                                                                                                                                                                                                                                                                                      For(dep2 = 0; (1 << dep2) < m; dep2++);
                                                                                                                                                                                                                                                                                                                                                                                                       st[0][0][i][j] = a[i][j]; // modify
                                                                                                                                                                                                  rep(i, 0, M) p[i] = 1 << i;
rep(i, 2, N) Log[i] = Log[i >> 1] + 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int qry(int x1, int y1, int x2, int y2){
                                                                                                                                                            void build(int n, int m, short a[][N]){
                                                                                                                                                                                                                                                                                                                                                               rep(i, 1, n+1) rep(j, 1, m+1)
                                                                              int Log[N], p[M], dep1, dep2;
short st[M][M][N][N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  //attention to range of k
                                     const int N = 1010, M = 11;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 return max(res1, res2);
namespace ST_2D{
```

2DSegTree3.2

```
void upd(int L,int R,int C,int l=0,int r=m,int rt=1) {
// 修改: 将区域内的值修改为区域最大值 + h
                                                                                                 struct seg {
   int ma[N<<2], la[N<<2];</pre>
                        // 询问:求区域最大值
                                                   const int N=1010;
                                                                            int n, m, q;
```

DP

// cout << setiosflags(ios::fixed); std::ios::sync_with_stdio(**false**);

std::cin.tie(0);

// cout << setprecision(3)

return 0;

DigDP

```
if (...) res += dfs(pos - 1, ..., lim & (i == up));
                                                                       if (!lim && ~f[...]) return f[...];
                       dfs(int pos, ..., bool lim) {
                                                                                                                          int up = lim ? dig[pos] : 9;
                                                  if (pos == -1) return ?;
                                                                                                                                                 rep(i, 0, up + 1)
                                                                                               11 res = 0;
11 f[];
```

```
else if (p2 > r) {tmp[i] = a[p1]; p1++;}
else if (a[p1], y <= a[p2],y) {tmp[i] = a[p1]; p1++;}</pre>
                                                                                                                                                                                                                                                                                                                                                                                     rep(i, l, pos) fen.add(fen.a1, a[i].z, —a[i].num);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          rep(i, 1, n+1) cin >> a[i].x >> a[i].y >> a[i].z;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            // desc : bud a cartesion tree from a[0] .. a[n-1]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   rep(i, 1, n+1) {
    if (i > 1 && a[i] == a[i-1]) { a[nn].num++;
                                                                                                                                                                                                                               while (pos <= mid && a[pos].y <= a[i].y) {
   fen.add(fen.a1, a[pos].z, a[pos].num);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    rep(i, 1, nn+1) ans[a[i].ans] += a[i].num;
                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, l, r+1){
    if (p1 > mid) {tmp[i] = a[p2]; p2++;}
                                                                                                                                                                                                                                                                                                                                      a[i].ans += fen.sum(fen.a1, a[i].z);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              // !!!! : return rt, a[n] will be rewrite
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(i, 0, n) cout << ans[i] << endl;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int cartesionTree(int a[], int n) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              else {tmp[i] = a[p2]; p2++;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             rep(i, l, r+1) a[i] = tmp[i];
                                                 a[1].ans = a[1].num - 1;
                                                                                                                                                        CDQ(1, mid); CDQ(mid+1, r);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     CartesianTree
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         sort(a+1, a+n+1, cmp);
                                                                                                                          int mid = 1 + r >> 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              a[++nn] = a[i];
void CDQ(int 1, int r){
                                                                                                                                                                                                     rep(i, mid+1, r+1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            a[nn].num = 1;
                                                                                                                                                                                                                                                                                                                                                                                                               p1 = 1; p2 = mid+1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      cin >> n >> k;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      int ls[N], rs[N];
                             if (1 == r) {
                                                                                                                                                                                                                                                                                        :++sod
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    // time : 0(N)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          } else {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     fen.ini(N);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 CDQ(1, nn);
                                                                               return;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        return 0;
                                                                                                                                                                                pos = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int main(){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               nn = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   3.4
```

if(x2>=mid+1) ans=max(ans, qry(x1, x2, y1, y2, mid+1, r, rt<<1|1));</pre>

if(x1<=mid) ans=max(ans, qry(x1, x2, y1, y2, 1, mid, rt<<1));</pre>

if(x1<=1&&r<=x2) return ans=max(ans, ma[rt].qry(y1, y2));</pre>

int mid=l+r>>1;

return ans;

CDO

3.3

}T;

ans=max(ans, la[rt].qry(y1, y2));

int ans=0;

int qry(int x1,int x2,int y1,int y2,int l=0,int r=n,int rt=1) {

if(x2>=mid+1) upd(x1, x2, y1, y2, c, mid+1, r, rt<<1|1);</pre>

 $if(x1 \le mid) upd(x1, x2, y1, y2, c, 1, mid, rt \le 1);$

void upd(int x1, int x2, int y1, int y2, int c, int l=0, int r=n, int rt=1) {

if(x1<=1&&r<=x2) return la[rt].upd(y1, y2, c), void();</pre>

ma[rt].upd(y1, y2, c);

seg ma[N<<2], la[N<<2];

struct Seg {

if(L<=mid) ans=max(ans, qry(L, R, 1, mid, rt<<1));
if(R>=mid+1) ans=max(ans, qry(L, R, mid+1, r, rt<<1|1));</pre>

if(L<=l&&r<=R) return ans=max(ans, ma[rt]);

int mid=l+r>>1;

return ans;

ans=max(ans, la[rt]);

int ans=0;

int

if(L<=l&&r<=R) return la[rt]=max(la[rt], c), void();</pre>

ma[rt]=max(ma[rt], c);

if(R>=mid+1) upd(L, R, c, mid+1, r, rt<<1|1);
qry(int L,int R,int l=0,int r=m,int rt=1) {</pre>

if(L<=mid) upd(L, R, c, l, mid, rt<<1);</pre>

int mid=1+r>>1

```
const int N = 200005;
int p1, p2, pos, n, k, nn, ans[N];
struct node{
  int x, y, z, num, ans;
  bool operator == (const node & b) const{
    return x == b.x & y == b.y & z == b.z;
} a[N], tmp[N];
bool cmp(node a, node b){
  if (a.x != b.x) return a.x < b.x;
  if (a.y != b.y) return a.y < b.y;
  return a.z < b.z;
}
bool cmp2(node a, node b){
    //if (a.y != b.y) return a.y < b.y;
    //return a.z < b.z;
  return a.z < b.z;
  return a.y < b.y;
  //return a.y < b.y;
  return a.x < column a.x
```

a[n] = INT_MAX; vi v(1, n); fill_n(1s, n, -1), fill_n(rs, n, -1);

```
r, rt); }
 ľ,
 ť,
   ó
= 0; cnt[rt][o] = qry(1, r, v,
rep(o, 0, 2) { 11 v
                                               KDT
                                                                                      // init
                                                 3.7
                while (a[v.back()] < a[i]) 1s[i] = v.back(), v.pop_back();</pre>
                                  v.pb(rs[v.back()] = i);
 rep(i, 0, n) {
                                                                   return v[1];
```

Fenwick

3.5

```
T sum(T *a, int p) { T r=0; for(; p>=1; p-=p & -p) r+=a[p]; return r; } T pre(int p) { return !p ? 0 : sum(a1, p) * p - sum(a2, p);} T qry(int 1,int r) {return pre(r)-pre(1-1); }
                                                                                                                                                                                                                                                                                                                                       void add(T *a, int p,T d) { for(; p<=n; p+=p & -p) a[p]+=d; }</pre>
                                                                                                                                                                                                                                                                                                 void ini(int _n){ fill_n(a1+1, n=_n, 0); fill_n(a2+1, n=_n, 0);
                                                                                                                                                                                                                                                                                                                                                                                                             add(a1, 1, d), add(a1, r+1, -d); add(a2, 1, d*(1-1)), add(a2, r+1, -d*r);
                                                                   // support : segment add, sum
                                                                                                                                                                                                                        static const int N =2e5+7;
                                                                                                                                                                                                                                                                                                                                                                             void add(int 1, int r, T d)
                                                                                                         // !!!! : use before init()!
                                                                                                                                                                                                                                                              int n;T a1[N],a2[N];
                                                                                                                                                  template<class T>
// index : [1, n]
                                // time : nlogn
                                                                                                                                                                                        struct Fenwick{
```

3.6 IntervalMaximumChangeTimes

```
o`
                                                                                                                                                                                                                                                                                                                                       R, v, o, 0, 1, mid, 1s)
                                                                                                                                                                                                                                                                    if(ma[ls | o] < v) return o ? qry(L, R, v, o, 0, 1, mid, ls) : qry(L, R, v, o,</pre>
inline int qry(int L, int R, 11 \, \&v, int O, bool spe, int 1, int r, int rt) { if(L > R) return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if(o == 0 && L <= mid) ans += qry(L, R, v, o, 0, 1, mid, 1s);
if(R > mid) ans += qry(L, R, v, o, 0, mid + 1, r, rs);
if(o == 1 && L <= mid) ans += qry(L, R, v, o, 0, 1, mid, 1s);</pre>
                                                                                                                                                                                                                                                                                                                                     == 0 ? qry(L,
                                                                                                                                                                                                                                                                                                                                int ans = cnt[rt][o] - cnt[ls | o][o] + (o
                                                                                                                                                                                                                                                                                                                                                                      qry(L, R, v, o, 0, mid + 1, r, rs));
                                                                                                                                                                  if(1 == r) return v = ma[rt], 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int mid = 1 + r >> 1, ans = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          void up(int 1, int r, int rt) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 ma[rt] = max(ma[ls], ma[rs])
                                                                                                                                                                                                                                                                                                                                                                                                     return \ v = ma[rt], ans;
                                                                                                    if(ma[rt] < v) return 0;
                                                                                                                                                                                                      int mid = 1 + r >> 1;
                                                                                                                                   if(L <= 1 && r <= R) {
                                                                                                                                                                                                                                        down(l, r, mid, rt);
                                                                                                                                                                                                                                                                                                      mid + 1, r, rs);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         down(l, r, mid, rt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return ans;
                                                                   if(!spe) {
```

```
struct P\{T \times [D]; bool operator < (const P &c) const \{ return \times [W] < c. \times [W]; \} p[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if(!k) {k=newnode(),nd[k].val=p,nd[k].son[0]=nd[k].son[1]=0,up(k);return;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 0, 2) if(al * nd[k].sz < nd[nd[k].son[i]].sz) o = 1;
if(o) { int cnt = 0; pia(k,cnt), k = build(1,cnt,w); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    nd[k].sz = 1; rep(i, 0, 2) nd[k].sz += nd[nd[k].son[i]].sz;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           ins(p, nd[k].son[nd[k].val.x[w] < p.x[w]], (w + 1) % D);
                                                                                                                                                                                                                                                                               struct Node{ T mi[D], ma[D]; int son[2], sz; P val; }nd[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     nd[k].mi[i] = min(nd[k].mi[i], nd[s].mi[i]);
nd[k].ma[i] = max(nd[k].ma[i], nd[s].ma[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                w=w,nth_element(p+1,p+mid,p+r+1),nd[k].val=p[mid];
                                                                                                                                                                                                                                                                                                                                                    void init() { rt = L = top = 0; } 
int newnode() { return top ? sta[top—] : ++L;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              nd[k].son[0] = build(1,mid-1, (w + 1) % D);
nd[k].son[1] = build(mid+1,r, (w + 1) % D);
                                                                                                                                                                                                                                                                                                                                                                                                                                                               rep(i, 0, D) {
nd[k].m1[i]=nd[k].ma[i]=nd[k].val.x[i]}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 // 抄上面这部分就好了, 下面部分是视具体题目定的
// 最近点(曼哈顿距离)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if(nd[k].son[0]) pia(nd[k].son[0],cnt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if(nd[k].son[1]) pia(nd[k].son[1],cnt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int mid = 1 + r >> 1, k = newnode();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   rep(o, 0, 2) if(nd[k].son[o])
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  p[++cnt]=nd[k].val,sta[++top]=k;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    int s = nd[k].son[o];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   int build(int l,int r,int w)
                                                                    D = 2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    void ins(P p, int &k, int w) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       void check(int &k, int w) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          void pia(int k, int &cnt) {
                                                                    const int N = 1e6 + 7,
                                                                                                                                                                                                                int rt, L, top, W, sta[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if(1 > r) return 0;
                                                                                                     const T INF = 1e9 + 7;
typedef int T; // modify
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               \mathsf{up}(\mathsf{k}), \mathsf{check}(\mathsf{k},\mathsf{w});
                                                                                                                                         const db al = 0.75;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           up(k); return k;
                                                                                                                                                                                                                                                                                                                                                                                                                              void up(int k) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              bool 0 = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           // O(nsqrt(n))
                                namespace KDT
```

```
void down(int x) { if(nd[x].rev) gao(nd[x].son[0]), gao(nd[x].son[1]), nd[x].rev =
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        void access(int x) { for(int y = 0; x; y = x, x = nd[x].fa) splay(x), nd[x].son[1]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int 1 = id(x), r = (1 ^ 1), s = nd[x].son[r];
if(nrt(y)) nd[z].son[id(y)] = x; nd[x].son[l] = s;
                                                                                                                                                                                                                                                                                                                                                                                                                nd[x].rev ^= 1, swap(nd[x].son[0], nd[x].son[1]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if(nrt(y)) (id(x) \land id(y)) ? rot(x) : rot(y);
                                                                                                                                              == x \mid \mid nd[fa].son[1] == x;
                                                                                                                                                                                                                                                                                            nd[x].sum = nd[ls].sum + nd[rs].sum + nd[x].val;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              void makeroot(int x) { access(x); splay(x); gao(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if(s) nd[s].fa = y; nd[y].fa = x; nd[x].fa = z;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             while(\operatorname{id}[x].\operatorname{son}[0]) down(x), x = \operatorname{nd}[x].\operatorname{son}[0];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int id(int u) { return nd[nd[u].fa].son[1] == u;
                                                                                                                                                                                                                                                             int ls = nd[x].son[0], rs = nd[x].son[1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int y = nd[x] fa, z = nd[y] fa;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for(int i = x; ; i = nd[i].fa)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             while(top) down(sta[top—]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if(!nrt(i)) break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           void link(int x, int y) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 while(nrt(x)) {
int y = nd[x].fa;
static const int N = ::N;
                                                                                                                                            return nd[fa].son[0]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         access(x); splay(x)
                                                          // if(no root) return 1
                               Node nd[N]; int sta[N];
                                                                                                                   int fa = nd[x].fa;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int findroot(int x)
                                                                                                                                                                                                                                    if(!x) return ;
                                                                                                                                                                                                                                                                                                                                                                                  if(!x) return ;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     void splay(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         sta[++top]
                                                                                                                                                                                                                                                                                                                                                       void gao(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 nb(y), up(x);
                                                                                   bool nrt(int \times) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int top = 0;
                                                                                                                                                                                                         void up(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          void rot(int x)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             splay(x);
return x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        = x' \cdot nb(x); 
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              // 换根
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            // 找根
                                                        rep(i, 0, D) ans += max(0, p.x[i] - nd[k].ma[i]) + max(0, nd[k].mi[i] - p.x[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(d, 0, D) ans += max(sqr(nd[u].mi[d] - p.x[d]), sqr(nd[u].ma[d] - p.x[d]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      ll dis = 0; rep(d, 0, D) dis += sqr(nd[u].val.x[d] - p.x[d]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        rep(i, 0, 2) if(nd[u].son[i]) qry(nd[u].son[i], ans);
                                                                                                                                                                                                         0, D) ans += abs(a.x[i] - b.x[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if(all_in) { ans = max(ans, ma); return; }
                                                                                                                                                                                                                                                                                                                                                       int ls = nd[k].son[0], rs = nd[k].son[1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 ans.push(-dis), ans.pop();
int ls = nd[u].son[0], rs = nd[u].son[1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if(d1 > dr) swap(d1, dr), swap(ls, rs);
                                                                                                                                                                                                                                                                                                                                                                                                                                           if(d1 > dr) swap(d1, dr), swap(ls, rs);
if(d1<ans) qry(p,1s,ans);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               sqr(int \times) \{ return 111 * \times * \times; \}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if(dr > -ans.top()) qry(p, rs);
if(dl > -ans.top()) qry(p, ls);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if(u_in) ans = max(ans, u_val);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      while(!ans.empty()) ans.pop();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if(no_in || ma < ans) return;
                                                                                                                                                                                                                                                                                                                     ans=min(ans,dis(p,nd[k].val));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  ll dr = rs ? Dis(p, rs) : -1;
                                                                                                                                                                                                                                                                                                                                                                                  T dl = 1s ? dis(p, 1s) : INF;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            11 d1 = 1s ? Dis(p, 1s) : -1;
                                                                                                                                                                                                                                                                                                                                                                                                                T dr = rs ? dis(p, rs) : INF;
                                                                                                                                                                                                                                                                                            void qry(P p, int k, T &ans) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      rep(i, 0, k) ans.push(1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(dr<ans) qry(p, rs, ans)</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       void qry(int u, int &ans) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   J 矩形区域的最大值(伪代码)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              priority_queue<11> ans;
void init() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      void qry(P p, int u) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              // 0(n \wedge (2-1/D))
                                                                                                                                                                       dis(P a, P b) {
T ans = 0; rep(i,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          Dis(P p, int u) {
T dis(P p, int k) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   // 距离点 ロ 第 k 远
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         11 ans = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    return ans;
                                                                                                                     return ans;
                                                                                                                                                                                                                                        return ans;
                                 T ans = 0;
                                                                                     // modify
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              LCT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      3.8
```

if(findroot(y) != x) nd[x].fa = y;

makeroot(x)

struct Node { int val, sum, fa, son[2]; bool rev; };
struct LCT {

```
if(findroot(y) != x) makeroot(y), nd[x].fa = y, add(y, x), up(y);
                                                                                                                                                                                                                                                                                                             int getAns() { access(1); splay(1); return nd[1].mxs; }
For(int y = 0; x; y = x, x = nd[x].fa) {
                                                  int &rs = nd[x].son[1];
                                                                                                                                                                                                         void link(int x, int y) {
                                                                                                    if(rs) add(x, rs);
                                                                          if(y) del(x, y);
                                                                                                                              rs = y, up(x);
                              splay(x);
                                                                                                                                                                                                                                       makeroot(x);
                                                                            if(findroot(y) == x \& nd[y].fa == x \& ind[y].son[0]) nd[y].fa = nd[x].son[1]
                                                                                                                                                                                void path(int x, int y) { makeroot(x); access(y); splay(y);
                                                                                                                                                                                                                                     void upd(int x, int c) { splay(x); nd[x].val = c; up(x); }
                        void cut(int x, int y) {
                                                                                                                                                                                                                                                                                                                 diameter
                                                                                                                                }
// nd[y]: 路径信息
                                                      makeroot(x);
                                                                                                        0, up(x);
                                                                                                                                                                                                           // 单点修改
                                                                                                                                                                                                                                                                                                               \GammaCT
  / 黒法
                                                                                                                                                                                                                                                                                                                 3.9
```

PerTrie 3.10

int sec(multiset<int> st) { return sz(st) > 1 ? *(++st.rbegin()) : 0; }

int fir(multiset<int> st) { return sz(st) ? *(st.rbegin()) : 0;

}lct;

```
rp.replace(cur, 字符数组 ); // 删除 cur 处的字符,换成字符数组rp.copy(cur, len, 字符数组 ); // 复制 cur 处开始的 len 个字符到字符数组
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     using namespace __gnu_cxx;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     rp.insert(cur, 字符数组 );
                                                                                                                                                         void init() { L = 0; }
                                                                                                                                                                                                                                                                                                                                                                                                               ed[now] = ed[pre];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rp.erase(cur, len);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            return ed[R];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  #include <ext/rope>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          rp.push_back(ch);
                                                                                                                                                                                                                                                                      now = ++L;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             Rope
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            ropecchar> rp;
                                                   struct Trie {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             3.11
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   }ac;
                                                                                                                                                                                                             void del(int x, int y) { Era(nd[x].chain, nd[y].lmx), Era(nd[x].path, nd[y].mxs); }
void add(int x, int y) { nd[x].chain.insert(nd[y].lmx), nd[x].path.insert(nd[y].mxs);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     Ma(nd[p].mxs, nd[ls].rmx + R); // 经过 p 父边的答案
Ma(nd[p].mxs, nd[rs].lmx + L); // 经过 u 向下实边的答案
Ma(nd[p].mxs, cha + sec(nd[p].chain) + (p > n)); // 處子树中到根路径最长的两条拼起来
                                   struct Node { int fa, son[2], lmx, rmx, mxs, sum; bool rev; multiset<int> chain, path;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            nd[p].lmx = max(nd[ls].lmx, nd[ls].sum + R); // 从链顶出发的最远距离nd[p].rmx = max(nd[rs].rmx, nd[rs].sum + L); // 从链底出发的最远距离nd[p].mxs = max(nd[ls].mxs, nd[rs].mxs); // mxs[p] 表示当前范围的直径
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              nd[p] .sum = nd[1s] .sum + nd[rs] .sum + (p > n); // 当前链的长度 int cha = fir(nd[p] .chain); // 从 p 沿處儿子走的最远距离 int L = max(cha, nd[1s].rmx) + (p > n); // 从 p 沿父亲走的最远距离 int R = max(cha, nd[rs].lmx) + (p > n); // 从 p 沿突光上的最远距离
                                                                                                                                                                                                                                                                                                                                                           rep(i, 1, n + m + 1) {
    nd[i].fa = nd[i].son[0] = nd[i].son[1] = nd[i].rev = 0;
    nd[i].lmx = nd[i].rmx = nd[i].mxs = nd[i].sum = 0;
void Era(multiset<int> &s, int x) { s.erase(s.find(x)); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               \inf p = x, Is = nd[x].son[0], rs = nd[x].son[1]; // 以下考虑的都是链 p 与链 p 的所有虚子树
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    Ma(nd[p].mxs, fir(nd[p].path)); // 虚子树的直径
                                                                                                                                                                                                                                                                                                                                                                                                                                                                nd[i].chain.clear(), nd[i].path.clear(),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        swap(nd[x].son[0], nd[x].son[1]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              swap(nd[x].lmx, nd[x].rmx);
                                                                                                                                        static const int N = 30303;
                                                                                                                                                                              Node nd[N]; int sta[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if(!x) return ;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   void access(int \times)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if(!x) return ;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          nd[x].rev ^{-1}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   void gao(int \times) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          void up(int \times) {
                                                                                                                                                                                                                                                                                                                    void init() {
                                                                                                     struct LCT {
```

```
int L, rt[N], ne[N * (M + 1)][2], cnt[N * (M + 1)], ed[N * (M + 1)];
                                                                                                                                 inline void upd(int &now, int pre, ll val, int ind, int dep = M
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if(cnt[ne[R][c \land 1]] - cnt[ne[L][c \land 1]]) c \land = 1;
                                                                                                                                                                                                                                                                                                                                         if(dep == -1) return ed[now] = ind, void();
                                                                                                                                                                                                                                                                                                                                                                                                              upd(ne[now][c], ne[pre][c], val, ind,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                inline int qry(int L, int R, ll val)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if(!(cnt[R] - cnt[L])) return -1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                           1/ 查询区间和 val 异或和最大的数下标
static const int N = ::N, M = 60;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      R = ne[R][c], L = ne[L][c]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  per(i, 0, M) {
   int c = val >> i & 1;
                                                                                                                                                                                                                                   ne[now][1] = ne[pre][1];
                                                                                                                                                                                                                                                                          cnt[now] = cnt[pre] + 1;
                                                                                                                                                                                                        ne[now][0] = ne[pre][0]
                                                                                                                                                                                                                                                                                                                                                                            int c = val >> dep & 1;
                                                                                               // 将当前数的信息存在叶子
```

// 删除 cur 开始的 1en 个字符 // 在 cur 处插入字符数组

// 在末尾插入字符

6

= 0, int 0 =

```
if(L > R) return ;
if(L <= 1 && r <= R && c < mi[rt][1]) return gao(rt, c), void();</pre>
                                                                                                                                                                                                                                                            void down(int rt) { gao(ls, mi[rt][0]); gao(rs, mi[rt][0]); }
void upd(int L, int R, int c, int l, int r, int rt) {
                                                                            build(1, mid, 1s); build(mid + 1, r, rs); up(rt);
                                                                                                                                                                                 sum[rt] += 111 * cnt[rt] * (c - mi[rt][0]);
                                                                                                                                                                                                                                                                                                                                                                                             if(L <= mid) upd(L, R, c, l, mid, ls);
if(R > mid) upd(L, R, c, mid + 1, r, rs);
                                                                                                                                                                                                                                                                                                                                                                       int mid = 1 + r >> 1; down(rt);
                                                                                                                                                           if(c <= mi[rt][0]) return ;</pre>
                                                  int mid = 1 + r >> 1;
                                                                                                                               void gao(int rt, int c)
                                                                                                                                                                                                              mi[rt][0] = c;
    return ;
                                                                                                                                                                                                                                                                                                                                                                                                                                                      up(rt);
// 取第 cur 个字符
// 取第 cur 个字符
// 提取从 cur 处开始的 1en 个字符
// 可持久化, 0(1), 直接拷贝根节点
                                                                                                                                                                                                                                                                    ^
                                                                                                                                                     * 1. 维护一正一反两个 rope
* 2. 翻转等价于交换两个子串
* 二)区间循环位移
* 1. 拆成多个子串, 重新安排它们的位置
* 三)区间 a -> b, b -> c, c -> d ....
* 1. 维护 26 个 rope
                                                      rp.substr(cur, len);
                                                                          rp[i] = rp[i - 1];
                                                                                                                                 * 一)翻转操作
```

 \mathbf{S}

3.12

rp.at(cur);

rp[cur];

Splay

```
struct Node { int val, fa, son[2], cnt, sz; bool rev; };
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  nd[L].son[0] = nd[L].son[1] = nd[L].rev = 0;
nd[L].cnt = nd[L].sz = 1;
                                                                                                                                                                                                                                 // if go to vertex p, must splay(p)
                                                                                                                                                                                                                                                                                                                                                                      int newnode(int c, int fa
                                                                                                                                                                                                                                                                                                               static const int N = ::N;
                                                                                                                                                                                                                                                                                                                                             int rt, L; Node nd[N];
                                                                                                                                                                                                                                                                                                                                                                                                                             nd[fa].son[o] = L;
                                                                                                                                                                                                                                                                                                                                                                                                  nd[++L].fa = fa;
                                                                                                                                                                                                                                                                                                                                                                                                                                                          nd[L].val = c;
                                                                                                                                                                                                        // id starts from 1
                                                                                                                                                                                                                                                                                          struct Splay {
                                                                                                                                                                                 // init
                                                                                                                 3.14
                                                                 }sed;
                                                                                                                              rep(i, 2, n + 1) lg[i] = lg[i >> 1] + 1;
rep(i, 0, n) a[0][i] = v[i];
rep(i, 1, lg[n] + 1) rep(j, 0, n - (1 << i) + 1) {
a[i][j] = max(a[i - 1][j], a[i - 1][j + (1 << i >> 1)]);
                                                                                                                                                                                                                                                                                                                                                                                 return max(a[i][1], a[i][r + 1 - (1 << i)]);
                                                    static const int N = 101010;
                                                                              int a[20][N], lg[N];
void build(int *v, int n){
                                                                                                                                                                                                                                                                                                                            if(1 > r) swap(1, r);
int i = lg[r - 1 + 1];
                                                                                                                                                                                                                                                                                                   int qry(int 1, int r){
                         struct ST{
// [0,n)
```

SegIntervalMax 3.13

```
if(mi[rt][0] == mi[ls | i][0]) cnt[rt] += cnt[ls | i];
                                                                                                                                                                                rep(i, 0, 2) mi[rt][i] = min(mi[1s][i], mi[rs][i]);
cnt[rt] = 0;
rep(i, 0, 2) {
                                                                                                                                                                                                                                                                                      else mi[rt][1] = min(mi[rt][1], mi[ls | i][0]);
                                                                                                                                                                                                                                                                                                                                                                                                   if(1 == r) {
    sum[rt] = mi[rt][0] = a[1]; //modify
    mi[rt][1] = inf; cnt[rt] = 1;
                                                                                                                                                                                                                                                                                                                                                                      void build(int l, int r, int rt) {
                                                                                                      11 sum[N]; int mi[N][2], cnt[N];
                                                                                                                                                       sum[rt] = sum[ls] + sum[rs];
                                                                         static const int N = ::N << 2;
                    区间求和
                                                                                                                                   void up(int rt) {
                      // 区间取 max,
                                                 struct Seg {
// 0(nlogn)
```

if(nd[u].rev) gao(nd[u].son[0]), gao(nd[u].son[1]), nd[u].rev = 0;

void down(int u)

int id(int u) { return nd[nd[u].fa].son[1] == u; nd[u].sz = nd[1s].sz + nd[rs].sz + nd[u].cnt;

void rot(int x)

int ls = nd[u].son[0], rs = nd[u].son[1];

if(!u) return ;

void up(int u) {

int y = nd[x].fa, z = nd[y].fa;
int l = id(x), r = (1 ^ 1), s = nd[x].son[r];

nd[u].rev ^= 1, swap(nd[u].son[@], nd[u].son[1]);

void init(int n) { rt = L = 0;

eturn L;

void gao(int u) {

if(!u) return

```
if(nd[x].r < nd[y].r) \ \{ down(x), nd[x].rs = merge(nd[x].rs, y), up(x); return x \}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(\min(nd[rt].getf(v[1]), nd[rt].getf(v[r])) >= \max(k.getf(v[1]), k.getf(v[r])))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if(max(mi[rt].getf(v[1]), mi[rt].getf(v[r])) <= min(k.getf(v[1]), k.getf(v[r])))</pre>
                                                                                                                                                                                                                                                                                                                               else { down(y), nd[y].ls = merge(x, nd[y].ls), up(y); return y;
                                                         if(sz < k) \times = u, splitk(nd[u].rs, k - sz - 1, nd[u].rs, y); else y = u, splitk(nd[u].ls, k, x, nd[u].ls);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if(k.getf(v[mid]) > nd[rt].getf(v[mid])) swap(k, nd[rt]);
if(1 == r) return;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if(k.getf(v[mid]) < mi[rt].getf(v[mid])) swap(k, mi[rt]);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               void upd(int L, int R, Node c, int l, int r, int rt) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  Node nd[N], mi[N]; // nd: max val; mi: min val; void _upd(Node k, int l, int r, int rt) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(mi[rt].k \le k.k)_min(k, l, mid, ls);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if(nd[rt].k > k.k) _upd(k, l, mid, ls);
else _upd(k, mid + 1, r, rs);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        o;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if(L <= mid) upd(L, R, c, l, mid, ls);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           void _min(Node k, int l, int r, int rt) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    Node(11 k, 11 b) : k(k), b(b) {}
11 getf(int x) const { return k * x +
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        else _min(k, mid + 1, r, rs);
  down(u);
int sz = nd[nd[u].ls].sz;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              static const int N = ::N << 2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if(L > R) return ;
if(L <= 1 && r <= R) {</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         _upd(c, l, r, rt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  _min(c, 1, r, rt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int mid = 1 + r >> 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int mid = 1 + r >> 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int mid = 1 + r >> 1;
                                                                                                                                                                                                            int merge(int x, int y) {
                                                                                                                                                                                                                                                                                                                                                             } else return x + y;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        Node(): k(0), b(0) {}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if(1 == r) return
                                                                                                                                                     else x = y = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                lcSegTree
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       return ;
                                                                                                                                                                                                                                        if(x && y) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 return ;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return ;
                                                                                                                         (n)dn
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 struct Node {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             struct Seg {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               11 k, b;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   3.16
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     // init
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              void down(int x) { if(nd[x].rev) gao(nd[x].ls), gao(nd[x].rs), nd[x].rev = 0; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      int rt, L; Node nd[N];
void init() { rt = L = 0; srand(time(0)); }
11 Rand() { return ((rand() * 111 << 32) ^ (rand() * 111 << 16) ^ rand()); }</pre>
if(z) nd[z].son[id(y)] = x; nd[x].son[r] = y; nd[y].son[1] = s;
if(s) nd[s].fa = y; nd[y].fa = x; nd[x].fa = z;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if(nd[u].val \le c) \times = u, splitc(nd[u].rs, c, nd[u].rs, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            struct Node { int val, cnt, sz, ls, rs; ll r; bool rev;};
                                                                                                                                                                                                        if(z != g) (id(x) ^ id(y)) ? rot(x) : rot(y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             else y = u, splitc(nd[u].ls, c, x, nd[u].ls);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               nd[x].sz = nd[ls].sz + nd[rs].sz + nd[x].cnt;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     nd[x].rev ^= 1, swap(nd[x].ls, nd[x].rs);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        void splitc(int u, int c, int &x, int &y) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            void splitk(int u, int k, int &x, int &y) {
  if(u) {
                                                                                                                                                                              int y = nd[x].fa, z = nd[y].fa;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                nd[L].1s = nd[L].rs = nd[L].rev =
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int ls = nd[x].ls, rs = nd[x].rs;
                                                                                                                     void splay(int x, int g = 0) {
  while(nd[x].fa != g) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                nd[L].cnt = nd[L].sz = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          struct fhqTreap {
   static const int N = ::N;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                // u -> (1 - k) (k+1 - L)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              nd[++L].r = Rand();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              // !!!: nd[].cnt == 1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int newnode(int c) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 (2 <) (2 =>) <- n //
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           } else \times = y = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if(!x) return ;
                                                                                                                                                                                                                                                                                                                                                                                                                       fhqTreap
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   // 不要修改 の 节点的值
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         nd[L].val = c;
                                                                                                                                                                                                                                                                                                    if(!g) rt = x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           void gao(int \times) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if(!x) return
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     // id starts from 1
                                                                (x)), up(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          void up(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      down(u);
                                                                                                                                                                                                                                          rot(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     return L;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             (n)dn
                                                                                                                                                                                                                                                                                                                                                                                                                         3.15
```

```
if(nd[x].r < nd[y].r) { x = newcopy(x), down(x), nd[x].rs = merge(nd[x].rs, y), up(x); return x; }
                                                                  \begin{array}{l} \textbf{int} \ sz = nd[nd[u].ls].sz; \\ \textbf{if}(sz < k) \ \times = u, \ splitk(nd[u].rs, \ k - sz - 1, \ nd[u].rs, \ y); \end{array} 
                                                                                                                                  else y = u, splitk(nd[u].ls, k, x, nd[u].ls);
                                                                                                                                                                                                                                                                        // sometimes do not need to newcopy
                                  u = newcopy(u), down(u);
                                                                                                                                                                                                                                                                                                          int merge(int x, int y) {
                                                                                                                                                                                                         } else x = y = 0;
                                                                                                                                                                                                                                                                                                                                               if(× && y) {
                                                            il qry(int p, int l, int r, int rt) {
    ll ans = max(abs(nd[rt].getf(v[p])), abs(mi[rt].getf(v[p])));
                                                                                                                                                                                                    if(p \le mid) ans = max(ans, qry(p, 1, mid, 1s));
                                                                                                                                                                                                                                           else ans = max(ans, qry(p, mid + 1, r, rs));
  rs);
if(R > mid) upd(L, R, c, mid + 1, r,
                                                                                                                                     if(1 == r) return ans;
                                                                                                                                                                     int mid = 1 + r >> 1
                                                                                                                                                                                                                                                                                                                                                                                                              perTreap
                                                                                                                                                                                                                                                                           return ans;
                                                                                                                                                                                                                                                                                                                                                                                                              3.17
                                                                                                                                                                                                                                                                                                                                               }sed:
```

```
rep(i, l, r + 1) tot += sz[sta[i]] – sz[wson[sta[i]]];
rep(i, l, r + 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 now += sz[sta[i]] — sz[wson[sta[i]]],
                                                                                                                                                                                                                                                                                                                (sz[v] > sz[wson[u]]) && (wson[u] = v)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         ċ
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int fa[N], son[N][2], rt, sta[N], top,
inline void up(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     inline int sbuild(int 1, int r)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if((now << 1) >= tot) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                int tot = 0, now = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int \times = sta[i];
                                                                                                                 void dfs(int u, int fa) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if(1 > r) return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         sum[x] = val[x];
                                                                                                                                                                                                                                                                                    sz[u] += sz[v];
                                                                                                                                                                                                 int v = to[i];
                                                                                                                                                                                                                                                                                                                                                                         int s = wson[u];
                                                                                                                                                                                                                                                            // nbd f[u]
                                                                                                                                                                                                                                                                                                                                                                                                   // h[u] = f[u]
                                                                                                                                                                                                                                                                                                                                                                                                                                                              [n]y pdn //
                                                                                                                                                                                                                                dfs(v, u);
                                                                                                                                               sz[u] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                               if(s)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            void down(int x) { if(nd[x].rev) gao(nd[x].ls), gao(nd[x].rs), nd[x].rev = 0; }
int rt[::N], L; Node nd[N];
void init() { fill_n(rt, L + 1, 0); L = 0; srand(time(0)); }
11 Rand() { return ((rand() * 111 << 32) ^ (rand() * 111 << 16) ^ rand()); }</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if(nd[u].val \le c) \times u, splitc(nd[u].rs, c, nd[u].rs, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    else y = u, splitc(nd[u].ls, c, x, nd[u].ls);
                                                                                                                                                                                                                                                                                                                                                                                                                             nd[x].sum = nd[ls].sum + nd[rs].sum + nd[x].val;
                                                                                                                                                                                                                                                                                        int newcopy(int x) { nd[++L] = nd[x]; return L; }
                                                                                                                                                                                                                                                                                                                                                                                                   nd[x].sz = nd[ls].sz + nd[rs].sz + nd[x].cnt;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        nd[x].rev \land = 1, swap(nd[x].ls, nd[x].rs);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            void splitk(int u, int k, int &x, int &y) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       void splitc(int u, int c, int &x, int &y)
                                                                                                                                                                                                      0
                                                                                                                                                                                                 nd[L].1s = nd[L].rs = nd[L].rev =
                                                                                                                                                                                                                                                                                                                                                                         int 1s = nd[x].1s, rs = nd[x].rs;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         u = newcopy(u), down(u);
                                                                                                                                         nd[L].val = nd[L].sum = c;
                                                                                                                                                                       nd[L].cnt = nd[L].sz = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 // u \rightarrow (1 - k) (k+1 - L)
                                                                                                                   nd[++L].r = Rand();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             // !!!: nd[].cnt == 1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         (c < c) (c = c) < c / (c < c)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          } else x = y = 0;
                                                                                         int newnode(int c) 
                                                                                                                                                                                                                                                                                                                                               if(!x) return ;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      void gao(int \&x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                x = newcopy(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if(!x) return
                                                                                                                                                                                                                                                                                                                     void up(int \times) \{
                                                                                                                                                                                                                                  return L;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  ;(n)dn
```

```
else { y = newcopy(y), down(y), nd[y].ls = merge(x, nd[y].ls), up(y); return y;
                                                                                                                                                                                                                                                                                                                                      int n, m, a[N], sz[N], wson[N], f[N][2], h[N][2];
int to[N << 1], ne[N << 1], hd[N], _;
inline void ae(int u, int v) { to[++_] = v, ne[_] = hd[u], hd[u] = _; }</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  for(int i = hd[u]; i; i = ne[i]) if(to[i] i = fa) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if(son[x][0]) sum[x] = sum[son[x][0]] * sum[x];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if(son[x][1])    sum[x] = sum[x] * sum[son[x][1]];
                                                                                  } else return \times + y;
                                                                                                                                                                                                                                          动态 dp_bst
                                                                                                                                                                                                                                                 3.18
```

struct Node { int val, cnt, sz, ls, rs; ll r, sum; bool rev; };

// 不要修改 の 节点的值

// id starts from 1

static const int N = 3e7;

struct fhqTreap {

rep(k, 1, 3) r.a[i][j] = max(r.a[i][j], a[i][k] + c.a[k][j]);

```
Fuzhou University
                                                                                                                                                                                                                                                                                                                                                                                                      int sz[N], wson[N], top[N], dep[N], id[N], _, par[N], who[N], leaf[N];
11 f[N][2], F[N][2];
struct Mat {
                                                                                                                                                                                                                             access(x); splay(x); nd[x].val.a[1][0] += y - a[x];
                                                                                                                                                                                                                                                             return max(nd[x].sum.a[0][0], nd[x].sum.a[1][0]);
                     for(int y = 0; x; y = x, x = nd[x].fa) {
                                                                                                                                                                                                           inline int upd(int x, int y) {
                                                                                                                                                         nd[x].son[1] = y; up(x);
      inline void access(int \times) {
                                                                                                                                                                                                                                                                                                                                               对态 dp 对链剖分
                                      splay(x);
if(nd[x].son[1]) {
// upd val[x]
                                                                                                                         // upd val[x]
                                                                                                                                                                                                                                            up(x); a[x] = y;
                                                                                                                                                                                                                                                                                                                                                                                      int n, a[N]; vi g[N];
namespace DP {
                                                                                                       if(y) {
                                                                                                                                                                                                                                                                                                 }lct;
                                                                                                                                                                                                                                                                                                                                                3.20
```

fa[son[x][0]] = fa[son[x][1]] = x;

son[x][0] = sbuild(1, i - 1); son[x][1] = sbuild(i + 1, r);

```
inline void e() { rep(i, 0, 3) rep(j, 0, 3) a[i][j] = (i != j) * (-inf); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              inline Mat operator * (const Mat &c) const
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        inline void build(int 1, int r, int rt) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    Mat r; rep(i, 0, 3) rep(j, 0, 3) {
    r.a[i][j] = a[i][0] + c.a[0][j];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if(1 == r) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             } return r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    Mat m[N << 2];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       11 a[3][3];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        struct Seg {
                                                                                                                                         for(int u = tp; u; f = u, u = wson[u]) {
  for(int i = hd[u]; i; i = ne[i]) if(to[i] != f && to[i] != wson[u]) {
    fa[build(to[i], u)] = u;
}
                                                                                                                                                                                                                                                                                                                                                                                                        n = _n; rt = build(1, 0);
rep(i, 1, n + 1) isr[i] = (son[fa[i]][0] != i && son[fa[i]][1] != i);
                                                                                                                                                                                                                                                                                                               for(int u = tp; u; u = wson[u]) sta[++top] = u;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        // u = fa[x], get h[u], val[u]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 inline int upd(int x, int y) {
// upd h[x], a[x] = y, val[x]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(isr[x] && fa[x]) {
    // get old f[x]
                                                                                                                   int build(int tp, int f) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    // get dp[1] by sum[rt]
                                                                                                                                                                                                                                                                                                                                     return sbuild(1, top);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           // get new f[x]
                                                                                                                                                                                                                                                                                                                                                                                    void build(int _n) {
                                                                                                                                                                                                                                      // upd val[u]
                        return x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      x = fa[x];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            (x)dn
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       (x)dn
(x)dn
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               else {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   while(x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     dfs(1, 0);
bst.build(n);
                                                                                                                                                                                                                                                                                         top = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       void init() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      }bst;
```

```
if(ls) nd[x].sum = nd[ls].sum * nd[x].sum;
                                                                                                                                                                                                        if(rs) nd[x].sum = nd[x].sum * nd[rs].sum;
                                                                                            struct Node { int fa, son[2]; Mat val, sum; };
                                                                                                                                                            nd[x].sum = nd[x].val;
                                                                                                                                 inline void up(int x) {
动态 dp_lct
                                                  int n, m, a[N], f[N][2];
namespace DP {
                                                                                                                    struct LCT {
   3.19
```

int mid = 1 + r >> 1; build(mid + 1, r, rs); build(1, mid, ls);

m[rt] = m[ls] * m[rs];

int u = who[1];

// set m[rt]

return ;

// calc F, f

inline void upd(int u, int l, int r, int rt) {

// set m[rt]

return ;

if(1 == r) {

(id[u] <= mid) ? upd(u, l, mid, ls) : upd(u, mid + 1, r, rs);

int mid = 1 + r >> 1;

```
void upd(int L, int R, 11 c, int 1 = 1, int r = n, int rt = 1) sum[rt] += c * (min(R, r) - max(L, 1) + 1);
                                                                                                                                                                                                                                                                                                                                                                                                                            if(L <= 1 && r <= R) return la[rt] += c, void();</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    ll ans = la[rt] * (min(R, r) - max(L, l) + 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if(L <= mid) ans += qry(L, R, 1, mid, 1s);
if(R > mid) ans += qry(L, R, mid + 1, r, rs);
                                   int mid = 1 + r >> 1;
build(1, mid, 1s); build(mid + 1, r, rs);
                                                                                                                                                                                                                                                                                                                      if(L <= mid) upd(L, R, c, l, mid, ls);
if(R > mid) upd(L, R, c, mid + 1, r, rs);
if(1 == r) return sum[rt] = a[1], void();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if(L <= 1 && r <= R) return sum[rt];</pre>
                                                                                                     sum[rt] = sum[ls] + sum[rs]
                                                                                                                                                                                                                                                                                   int mid = 1 + r >> 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int mid = 1 + r >> 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return ans;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          }sed;
                                                                    inline void qry(int L, int R, int l, int r, int rt, Mat &ans) {
  if(rt == 1) ans.e();
                                                                                                                                                                                                                                                                                                                                                                                           // if(s) top[s] = top[c], dfs2(s, c, g), leaf[c] = leaf[s],
```

 $if(L \le 1 \& R \le R) return$ ans = ans * m[rt], void(),

int mid = 1 + r >> 1;

m[rt] = m[ls] * m[rs];

if(L <= mid) qry(L, R, l, mid, ls, ans);
if(R > mid) qry(L, R, mid + 1, r, rs, ans);

inline pair<ll, ll> qry(int x) {
 Mat tmp; seg.qry(id[x], id[leaf[x]], 1, n, 1, tmp);
 ll f0 = max(tmp.a[0][0], tmp.a[0][1], tmp.a[0][2]); 11 f1 = max(tmp.a[1][0], tmp.a[1][1], tmp.a[1][2]);

// else leaf[c] = c;

struct HeavyChain{

F[p][1] += c - a[p], a[p] = c;

int v = p;

void upd(int p, int c) {

return mp(f0, f1);

线段树优化建图 3.23

```
t[0] = ++tim, t[1] = ++tim, liu(t[0], t[1], 0);
if (rt / 2) liu(fa[0], t[0], 0), liu(t[1], fa[1], 0);
if (l == r) { p[1] = t[0]; return; }
build(l, mid, ls); build(mid+1, r, rs);
                                                                                                                                                                                    vectorpii> g[M];
void init() { rep(i, 0, tim+1) g[i].clear(); tim = 0; }
void liu(int u, int v, int w) { g[u].pb(mp(v, w)); }
void build(int l, int r, int rt) {
   int *t = id[rt], *fa = id[rt / 2], mid = 1 + r >> 1;
                                                                                                                             static const int N = :: N \ll 2, M = N + Q;
                                                                                                                                                           int id[N][2], p[::N], tim;
                                                                  #define ls (rt << 1)
                                                                                             #define rs (ls | 1)
                                           struct SegGraph {
                                                                                                                                                                                                           f[u][0] = _f.fi, f[u][1] = _f.se, v = fa;
while(v) {
  int u = top[v], fa = par[u];
                                                                                       pair<ll, ll> _f = qry(u);
                                                             seg.upd(v, 1, n, 1);
                                                                                                                                                                                                                                                                                                                                                            seg.build(1, n, 1);
                                                                                                                                                  // upd F[fa]
                                                                                                                                                                                                                                                                                                                                hc.Build(g);
                                                                                                                         if(fa) {
                                                                                                                                                                                                                                                                                                       void work() {
```

常见转化 3.21

void link(int l, int r, int rt, int L, int R, int w, int o) {

int *t = id[rt], mid = 1 + r >> 1;
if (L <= 1 && R >= r) {

if (0) liu(t[0], tim, w);

else liu(tim, t[o], w);

```
top
* 单点修改,区间查询 -> 单点修改,前缀查询 -> 后缀修改,单点查询
* 树剖路径问题:重链区间修改,轻边暴力维护。轻边深度小的点一定在重链上,深度大的一定是
```

区回加区回水型 标记不下传 3.22

```
void build(int \bar{1} = 1, int r = n, int rt = 1) {
                         struct Seg {
   static const int N = ::N << 2;</pre>
                                                                           11 sum[N], la[N];
                                                                                                                                la[rt] = 0;
int n; ll a[N];
```

void link(int li, int ri, int l2, int r2, int w, int n) {

// [11, r1] \rightarrow [12, r2] weight = w

link(1, n, 1, 12, r2, 0, 0); link(1, n, 1, 11, r1, w, 1);

if (R > mid) link(mid+1, r, rs, L, R, w, 0); if (L <= mid) link(l, mid, ls, L, R, w, 0);</pre>

```
3.24 覆盖大于 k 次的矩形面积
```

} };

```
len[0][rt] = (1 == r) ? 0 : len[0][ls] + len[0][rs]; len[1][rt] = (1 == r) ? 0 : len[1][ls] + len[1][rs];
                                                                                                                                                                                                                                                               len[1][rt] = (1 == r) ? 0 : len[0][ls] + len[0][rs];
                                                                                                                                                                                                                                                                                                                                                                                                                            void upd(int L, int R, int c, int l, int r, int rt) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if(L <= mid) upd(L, R, c, 1, mid, 1s);
if(R > mid) upd(L, R, c, mid + 1, r, rs);
                                                                                                        void up(int rt, int 1, int r) {
                                                   static const int N = ::N << 2;
                                                                                                                                                       len[0][rt] = r - 1 + 1; len[1][rt] = r - 1 + 1;
                                                                                                                                                                                                                                        len[0][rt] = r - 1 + 1;
                                                                                                                                                                                                            else_if(la[rt] >= 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                    if(L <= 1 && r <= R) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int mid = 1 + r >> 1;
// 这里是覆盖次数大于 1 次的
                                                                           int la[N], len[2][N];
                                                                                                                                if(la[rt] >= 2) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     up(rt, 1, r);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 la[rt] += c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         up(rt, 1, r);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return ;
                                                                                                                                                                                                                                                                                               } else ·
                        struct Seg {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            }seg;
```

3.25 高维偏序

```
rep(i, 0, n) {
    tmp.set(pos[j][i]);
    if (i == id * B - 1) s[j][id++] = tmp;
}

int qry(node a) {
    bitset<N> ans; ans.set();
    rep(j, 0, k) {
        int ed = lower_bound(all(V[j]), mp(V[j][a.d[j]].fi, n+1)) - V[j].begin() - 1;
        bitset<N> tmp;int id = ed / B, st = id ? (id - 1) * B : 0;
        if (id) tmp = s[j][id - 1];
        rep(i, st, ed+1) tmp[pos[j][i]] = 1;
        ans &= tmp;
    }
    return ans.count();
}
```

\mathbf{Game}

4.1 Nim 积

4.2 SurNum

```
int sgn(11 x) { return !x ? 0 : (x > 0 ? 1 : -1); }
struct SurNum {
    11 x, k; int op;
    SurNum() { x = k = op = 0; }
    SurNum(11 x, 11 k, 11 op = 0) :x(x), k(k), op(op) { }
    SurNum(const SurNum &a) { *this = a; }
    inline SurNum Simplify() {
```

```
while (op = getDir(S, a, b)) S = ((op == 1) ? S.goRight() : S.goLeft());
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   Η,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                SurNum y; if (x.x \le 0 \& x.k == 0) y = x, y.x—; else y = p + x >>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if (x, x) >= 0 \& x, k == 0) y = x, y, x++; else y = x + q >>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    \Leftrightarrow
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                SurTri(SurNum p, SurNum x, SurNum q) :p(p), x(x), q(q) SurTri(const SurTri &a) { *this = a; }
friend inline SurNum operator -= (SurNum &a, SurNum b)
                                                                                    Ş
                                                                                                                                                                     friend inline SurNum getMid(SurNum a, SurNum b)
                                                                                                                                                                                                                                                                                                            if (op == 1) { printf("+inf\n"); return; }
                                                                                                                                                                                                                                                                                                                                        if (op == -1) { printf("-inf\n"); return;
                                                                                  friend inline SurNum operator >> (SurNum a,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int getDir(SurTri Š, SurNum a, SurNum b)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return SurNum(a1, a2, a3).Simplify();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     &a1, &a2, &a3);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if (a <= S.x && b <= S.x) return -1;
if (a >= S.x && b >= S.x) return 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if (a < S.x && S.x < b) return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 SurNum getValue(SurNum a, SurNum b)
                                                                                                                                                                                                                                                                                                                                                                    printf("%lld/%lld\n'', x, 1 << k),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   p.print(), x.print(), q.print();
                                                                                                              return a.k += k, a.Simplify();
                                                                                                                                                                                                                                                                                                                                                                                                                          inline static SurNum read() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       printf("\n\nSurTri:\n\n");
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     SurTri S(—_inf, _0, _inf);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              SurNum p, x, q;
SurTri() { p = x = q = \_0; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      _0(0, 0, 0), _inf(0, 0, 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    return SurTri(p, y, x);
                                                                                                                                                                                                                                                     inline void print() const
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return SurTri(x, y, q);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     scanf("%11d%11d%11d",
                                                                                                                                                                                                                                                                                    printf("SurNum:\n");
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             printf("\nend\n\n");
                                                                                                                                                                                               return a + b \gg 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  struct SurCalculator {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         SurTri goRight() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               SurTri goLeft() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                         11 a1, a2, a3;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          void print() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                return S.x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               assert(0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                struct SurTri {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     SurNum y;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                int op;
```

```
friend inline bool operator >= (const SurNum &a, const SurNum &b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       friend inline bool operator == (const SurNum &a, const SurNum &b) return compare(a, b) == \theta;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          friend inline bool operator <= (const SurNum &a, const SurNum &b)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              &b)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    friend inline bool operator < (const SurNum &a, const SurNum &b)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   friend inline bool operator > (const SurNum &a, const SurNum &b)
return compare(a, b) == 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              const SurNum
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              grow(a, b); return SurNum(a.x + b.x, a.k, 0).Simplify();
                                                                                            friend inline int sgn(const SurNum &a) { return sgn(a.x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if (a.op == -1 || b.op == -1) return SurNum(0, 0, -1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               friend inline SurNum operator += (SurNum &a, SurNum b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               friend inline SurNum operator + (SurNum a, SurNum b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if (a.op == 1 || b.op == 1) return SurNum(0, 0, 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   SurNum b)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           friend inline SurNum operator — (const SurNum &a)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         friend inline bool operator != (const SurNum &a,
                                                                                                                                                                                                                                                                                                                                friend inline void grow(SurNum &a, SurNum &b)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                   friend inline int compare(SurNum a, SurNum b)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      – (SurNum a,
while (x \% 2 == 0 \&\& k > 0) \times /= 2,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 return SurNum(—a.x, a.k, —a.op)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int opa = sgn(a), opb = sgn(b);
if (opa < opb) return -1;
if (opa > opb) return 1;
                                                                                                                                                                                                                                 ⊩ KK;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if (a.op < b.op) return -1;
if (a.op > b.op) return 1;
if (a.op != 0) return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              friend inline SurNum operator
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           return compare(a, b) ==-1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return compare(a, b) <= 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          return compare(a, b) i = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                return compare(a, b) >= 0;
                                                                                                                                                            Simplify();
if (kk < k) return 0;
x *= 111 << kk - k, k</pre>
                                                                                                                                                                                                                                                                                                                                                                    int k = max(a.k, b.k);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    return sgn(a.x - b.x);
                                                                                                                           inline bool Grow(int kk)
                                                                                                                                                                                                                                                                                                                                                                                                a.Grow(k), b.Grow(k);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              return a = a + b;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    return a + (-b);
                              return *this;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  grow(a, b);
                                                                                                                                                                                                                                                                     return 1;
```

```
if(sign(a[i] * a[i] - a[j] * a[j] - a[k] * a[k] - a[j] * a[k]) >= 0) return p[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              P proj(L 1, P p) { return 1.a + (1.b - 1.a) * (dot(p-1.a, 1.b-1.a) / (1.b-1.a).
                                                                                                                                                                                                                                                                                                                                                                                                                     rep(i, 0, 3) a[i] = (p[(i + 2) % 3] - p[(i + 1) % 3]).len();
rep(i, 0, 3) {
  int j = (i + 1) % 3, k = (i + 2) % 3;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                auto Rand = [&] () { return rand() % 10000 / 5000 * pi; }; P ans(0, 0); rep(i, 0, n) ans = ans + p[i]; ans = ans / n; db len = 0; rep(i, 0, n) len += (ans - p[i]).len();
                                                                                                                                                            // sqrt((a ^ 2 + b ^ 2 + c ^ 2 + 4 * sqrt(3) * area) / 2)
// 如果有重点,大于 2 的直接用模拟退火法
o = outC(p[i], p[j], p[k]), r = abs(o-p[k]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           P np(ans.x + t * sin(ang), ans.y + t * cos(ang));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if(det(p[0], p[1], p[2]) < 0) swap(p[1], p[2]);
P q1 = (p[2] - p[0]).rot(pi / 3) + p[0];
P q2 = (p[0] - p[1]).rot(pi / 3) + p[1];</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           c = 0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      isLL(db a0, db b0, db c0, db a1, db b1, db c1) { db d = a0 * b1 - a1 * b0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           db k = 0; rep(i, 0, n) k += (np - p[i]).len();
if(sign(len - k) > 0) ans = np, len = k;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           db s2 = -\det(12.b - 12.a, 11.b - 12.a);
return (11.a * s2 + 11.b * s1) / (s1 + s2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       isLL(L 1, db a, db b, db c) \{ // ax + by \}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                return isLL(L(q1, p[1]), L(q2, p[2]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        db s1 = det(12.b - 12.a, 11.a - 12.a);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     return (1.a * v + 1.b * u) / (u + v);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    db \dot{u} = a * 1.a.x + b * 1.a.y + c;
db v = -(a * 1.b.x + b * 1.b.y + c);
                                                                                                                                                                                                                                                                                                                      if(n = 2) return (p[0] + p[1]) / 2;

if(n = 3) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      由线
                                                                                                                                                                                                                                                           int n = sz(p); assert(n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      直线、
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 db t = 10000; // modify
                                                                                                                                                                                                                                                                                             if(n == 1) return p[0];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              // 【点到直线投影(垂足)】
                                                                                                                                                                                                                        P fermat(vector<P> p)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       P isLL(L 11, L 12) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               db ang = Rand();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      线段、
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 while(t > eps) {
                                                                   return C(o,r);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            // 【直线交点】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               return ans;
                                                                                                                                                                                                                                                                                                                                                                                         db a[3];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 len2()); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        ર્સ
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           5.2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    db Xm = p[m].x, lim = min(solve(1, m, p), solve(m + 1, r, p)); inplace_merge(p.begin() + 1, p.begin() + m + 1, p.begin() + r + 1, [&](P a, P b){
                                                                                                                                                                                                                                                                                                                                                                                                                                      };
db rad(P p1, P p2) { return atan2l(det(p1, p2), dot(p1, p2)); } // p1 与 p2 的夹角,有方
                                                                                                                                                                                                                                                                                                       int quad() const { return sign(y) > 0 || (sign(y) == 0 && sign(x) >= 0); }
                                                                                                                                                                                                                                                                                                                                        P rot90() { return P(-y, x); }
P rot(db a) { return P(cos(a) * x - sin(a) * y, cos(a) * y + sin(a) * x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(i, 1, r + 1) if(fabs(p[i].x - Xm) <= lim) V.pb(p[i]);
rep(i, 0, sz(V)) rep(j, i + 1, sz(V)) {
   if(fabs(V[j].y - V[i].y) >= lim) break;
   T dis = (V[i] - V[j]).len();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              sort(all(A), [\&](P a, P b)\{return a.x < b.x;\});
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          bool cmp(const pii &a, const pii &b) { // 级角排序
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   o = (p[i] + p[j]) / 2, r = abs(o-p[j]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(sgn(abs(o-p[k])-r) \leftarrow 0) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if(sgn(abs(o-p[j])-r) \leftarrow 0) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           int o = a > pii(0, 0), t = b > pii(0, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if(sgn(abs(o-p[i])-r) \leftarrow 0) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          namespace NearestPoints \{ // sz(A) <= 1e5 \}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        db solve(int 1, int r, vector<P> &p) {
                                                                                                                                                                                                                                                                                                                                                                                                      P norm() { return *this / len(); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              return solve(0, sz(A) - 1, A);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(1 == r) return 1e100
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        random_shuffle(p , p + n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    lim = min(lim, dis);
                                                                                                                                                                                          向量
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if(0) = t return 0 < t;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  }
db solve(vector<P> A) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         return a.y < b.y;});
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        int m = 1 + r >> 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           return det(a, b) > 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       0 = p[i], r = 0; r = 0; r = 0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        P o = p[0]; db r = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             C Mincir(P *p, int n){
                                                                                                                                                                                       1、基础点、
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       // 【点集中最近点对】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          vector<P> V;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    return lim;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          // 【最小圆覆盖】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              rep(i,1,n) {
                                                                                                                                                                                                                                                                              struct P {
```

```
return (b.y - a.y) * 111 * (c.x - b.x) <= (c.y - b.y) * 111 * (b.x - a.x);
                                                                             (++(uet(A[(1+1) \% n]-A[i], A[(j+1) \% n]-A[j]) >= 0 ? j : i)) \% = n, 
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          void ins(int x, int y) { ins(h1, P(x, y)); ins(h2, P(x, -y)); } bool in(int x, int y) { return in(h1, P(x, y)) && in(h2, P(x, -y)); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if(!sz(h)) return 0;
if(p.x < h.begin()->se.x || p.x > h.rbegin()->se.x) return 0;
rep(i, 1, n) (A[i] < A[1]) & (1 = i), (A[r] < A[i]) & (r = i);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if(sgn(b.x - a.x)) return (p.x - a.x) / (b.x - a.x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if(ao(11->se, 1->se, p)) h.erase(1); else break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             auto rr = r; rr++; if(rr == h.end()) break;
if(ao(p, r\rightarrow se, rr\rightarrow se) h.erase(r); else break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    while(1) {
    auto 1 = pos; if(1 == h.begin()) break; --1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          auto 11 = 1; if(11 == h.begin()) break; --11
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       auto r = pos; r++; if(r == h.end()) break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               P operator [] (const int&n) {return d[n];}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     <= 1->se.y;
                                                                                                                                                                                                                                                                                                     // 0(nlogn)
// 插入点,询问点在不在凸包内部(包括边界)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               return (p.y - a.y) / (b.y - a.y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              P d[10]; int dn; // d[dn] = d[0]
                                                                                              do (++(det(A[(i + 1) % n]- A[i],
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       if(p.x == 1->se.x) return p.y
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       void ins(map<int, P> &h, P p) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             namespace ConvecIntersection{ // ?
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   bool in(map<int, P> &h, P p) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      auto 1 = h.lower_bound(p.x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          return ao(1—>se, p, r—>se);
                                   db res = (A[1]-A[r]).len();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if(in(h, p)) return;
h[p.x] = p;
auto pos = h.find(p.x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               typedef pair<db, int> pdi;
                                                                                                                                                                                                                                                                                                                                                                                                                                   bool ao(P a, P b, P c) {
                                                                                                                                                                   while(i != 1 || j != r);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                int n;pdi res[1000005];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               db getLoc(P a,P b,P p){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                      // 包括边界: 小等于
                                                                                                                                                                                                                                                                                                                                                                                                 map<int, P> h1, h2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 const int N = 1005
                                                                       int i = 1, j = r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           auto r = 1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      while(1) {
                                                                                                                                                                                                                                                                                                                                                                namespace DCH {
                                                                                                                                                                                                         return res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             struct Rec
                                                                                                                                                                                                                                                                  // 【动态凸包】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         //【凸包交】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   sort(all(ps)); vector<P> qs;
for(int i = 0; i < n; qs.pb(ps[i++])) {
    while(sz(qs) > 1 && sign(det(qs[sz(qs) - 2], qs.back(), ps[i])) <= 0) qs.pop_back();</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    \mbox{\it while}(sz(qs) > t \& sign(det(qs[sz(qs) - 2], qs.back(), ps[i])) <= 0) qs.pop\_back();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return min(min(disToSeg(b, a.s), disToSeg(b, a.t)), min(disToSeg(a, b.s), disToSeg(a,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return sign(dot(1.a, p, 1.b)) * sign(dot(1.b, p, 1.a)) == 1 ? disToL(1, p) : min((p 1.a).len(), (p-1.b).len());
                                                                                                 bool isSSr(const L &a, const L &b){ db c1 = det(a.t - a.s, b.s - a.s), c2 = det(a.t - a.s, b.t - a.s); db c3 = det(b.t - b.s, a.s - b.s), c4 = det(b.t - b.s, a.t - b.s);
                                                                                                                                                                                                                                                                                                   db c1 = det(a.t - a.s, b.s - a.s), c2 = det(a.t - a.s, b.t - a.s);
db c3 = det(b.t - b.s, a.s - b.s), c4 = det(b.t - b.s, a.t - b.s);
return sign(c1) * sign(c2) <= 0 && sign(c3) * sign(c4) <= 0 &&
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                bool isLS(P a1, P a2, P b1, P b2) { // 判断直线线段是否相交(端点也算)
db c1 = det(a2 - a1, b1 - a1), c2 = det(a2 - a1, b2 - a1);
                                                                                                                                                                                             return sign(c1) * sign(c2) < 0 && sign(c3) * sign(c4) < 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   for(int i = n - 2, t = sz(qs); i >= 0; qs.pb(ps[i-])) {
                                                                                                                                                                                                                                                                                                                                                                                                    sign(max(a.s.x, a.t.x) - min(b.s.x, b.t.x)) >= 0 &&
                                                                                                                                                                                                                                                                                                                                                                                                                                     sign(max(b.s.x, b.t.x) - min(a.s.x, a.t.x)) >= 0 &&
                                                                                                                                                                                                                                                                                                                                                                                                                                                                    sign(max(a.s.y, a.t.y) - min(b.s.y, b.t.y)) >= 0 &&
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     sign(max(b.s.y, b.t.y) - min(a.s.y, a.t.y)) >= 0;
  - a0 * c1) / d;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          return fabs(det(1.a, p, 1.b) / (1.b - 1.a).len());
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int n = sz(ps); if(n \le 1) return ps;
     a1 * c0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      vector<P> convexHull(vector<P> ps) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     return sign(c1) * sign(c2) <= 0;
     b1 * c0,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      disSS(L a, L b){
if(isSS(a, b)) return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             diameter(vector<P> A)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       qs.pop_back(); return
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(n <= 1) return 0;</pre>
     return P(b0 * c1 -
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    db disToL(L l, P p) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     db disToS(L l, P p) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int 1 = 0, r = 0;
                                                                                                                                                                                                                                                               bool isSS(L a,L b){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int n = sz(A);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       // 【凸包最远点对】
                                                                  // 【线相交判定】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          // 【线到线距离】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  // 【点到线距离】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                / 【求凸句】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               b.t)));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             က်
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             5.3
```

db dis = (c1.0 - c2.0).len();

```
= 1;
                                                                                                                                                                                                                                                                                                                                     = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                if(det(q[0], q1, q2) < 0) swap(q1, q2), f2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           db res = f1 == f2 ? area(ps) : —area(ps);
                                                                                                                                                                                                                                                                                                                                   Ţ
                                                                                                                                                                                                                                                                                                                                   if(det(p[0], p1, p2) < 0) swap(p1, p2),
                                                                            polyInter(vector<P> &p, vector<P> &q) {
                                                                                                                                                             // if(area(p) < 0) reverse(all(p));
                                                                                                                                                                                       // if(area(q) < 0) reverse(all(q));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                            vector<P> ps({p[0], p1, p2});
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         convexCut(ps, L(q[0], q1));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             convexCut(ps, L(q2, q[0]));
                                                                                                                                                                                                                                                                                                                                                                                     P q1 = q[j], q2 = q[j + 1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        // 相离4: 外切3: 相交2: 内切1: 内含0:
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     convexCut(ps, L(q1, q2));
                                                                                                                                                                                                                                           rep(i, 1, n - 1) {
P p1 = p[i], p2 = p[i + 1];
                     <u>=</u> =
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int relCC(C A, C B) { // 两圆关系
                                                                                                        int n = sz(p), m = sz(q);
if(n < 3 || m < 3) return 0;</pre>
                   // 【平面图欧拉定理】 N + F -
                                             【简单多边形求面积交】
                                                                                                                                                                                                                                                                                                                                                               rep(j, 1, m-1)
                                                                                                                                                                                                                                                                                                                                                                                                                   bool f2 = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ans += res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         return fabs(ans);
                                                                                                                                                                                                                                                                                                    bool f1 = 0;
                                                                                                                                                                                                                        db ans = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            // 注意相等关系
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            國
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               // 【两圆关系】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                6
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                5.6
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          \mathsf{rt} \; + = \; \big( (\mathsf{r[i][j+1]} - \mathsf{r[i][j]}) \; \; \mathsf{a} \; + \; \mathsf{r[i][j]}) \; / \; \big( (\mathsf{r[i][j+1]} - \mathsf{r[i][j]}) \; \; \mathsf{b} \; + \; \\
                                                                                                                                                                                                                                                                                                                                         if(sgn((r[i][j+1] - r[i][j]) * (r[t][g+1] - r[t][g])) < 0 || i < t)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         else if(du < 0 && dv >= 0) res[sz++] = pdi(s1 / (s1 + s2) , -1);
                                                                                                                                                                                                                                                                                                                                                                 res[sz++] = pdi(getLoc(r[i][j], r[i][j+1], r[t][g]), 1);
res[sz++] = pdi(getLoc(r[i][j], r[i][j+1], r[t][g+1]), -1);
                                                                                                                                                                                                                                                                                                                                                                                                                            else {
    db s1 = (r[i][j] - r[t][g]) / (r[t][g+1] - r[t][g]);
    db s2 = (r[t][g+1] - r[t][g]) / (r[i][j+1] - r[t][g]);
    if(du >= 0 && dv < 0) res[sz++] = pdi(s1 / (s1 + s2) , 1);</pre>
                                                                                                                                                                                                                                                      int du = sgn((r[i][j+1] - r[i][j]) / (r[t][g] - r[i][j]));
int dv = sgn((r[i][j+1] - r[i][j]) / (r[t][g+1] - r[i][j]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if(cnt == 0 && sgn(res[t].fi - res[t+1].fi)) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if(b < 0) continue; if(b > 1) b = 1;
                                                                                                                                         res[sz++] = pdi(0,0);res[sz++] = pdi(1,0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if(a < 0) a = 0; if(a > 1) break
                                                                                  rep(i,0,n) rep(j,0,r[i].dn){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  db b = res[t+1].fi;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            db \ a = res[t].fi;
                                                                                                                                                                                                  if(t == i) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                sort(res , res + sz);
                                                                                                                                                                                                                            rep(g,0,r[t].dn) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   cnt += res[t].se;
                                                                                                                                                                                                                                                                                                               if(!du && !dv)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int cnt = 0; —sz;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             rep(t,0,sz) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            return rt / 2;}}
                                                                                                                                                                        rep(t,0,n) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                三角形
                                                                                                                 int sz=0;
}
db work() {
                                                          db rt=0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       4
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       5.4
```

db dB = b.len2(), dC = c.len2(), d = 2 * det(b, c); return A - P(b.y * dC - c.y * dB, c.x * dB - b.x * dC) / d;

P outC(P A, P B, P C) { // 外心

(心) | | $P \ b = B - A$, C = C - A;

return fz / fm

fz = fz + (p[0] + p[i] + p[i + 1]) * t / 3;

fm += t;

baryC(P p[], int n) { // 重心 P fz(0, 0); db fm = 0; rep(i, 1, n - 1) { db t = det(p[0], p[i], p[i + 1]);

```
2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        ans[cnt] += ang * c[i].r * c[i].r / 2 - \sin(ang) * c[i].r * c[i].r /
                            if(sign(dot(s - p1, t - p1)) \le 0 \& sign(dot(s - p2, t - p2) \le 0))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     rep(j,0,i) if(c[i]==c[j]) cnt++;
rep(j,0,n) if(j!=i&&!(c[i]==c[j])&&overlap(c[j],c[i])) cnt++;
                                                        return r * r * (rad(s, p1) + rad(p2, t)) + det(p1, p2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         P p,T ang;int delta;
E(){} E(P p,T ang,int delta):p(p),ang(ang),delta(delta){}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  bool overlap(C a,C b) {return sgn(a.r\rightarrowb.r\rightarrowabs(a.o\rightarrowb.o))>=0;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           bool operator < (const E&b) const {return ang<b.ang;}</pre>
                                                                                  else return r * r * rad(s, t);
} else if(b1) return r * r * rad(s, p1) + det(p1, t);
else if(b2) return r * r * rad(p2, t) + det(s, p2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              ans[cnt] += evt[j].p / evt[j+1].p / 2;
db ang = evt[j + 1].ang - evt[j].ang;
if(ang < 0) ang += pi * 2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        rep(j,0,2) a[j]=(pts[j]-c[i].0).arg();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if(!sz(evt)) ans[cnt] += pi*c[i].r*c[i].r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              memset(ans , 0 , sizeof(T) * (n + 1)); rep(i,0,n) {
                                                                                                                                                                                                                                                                                                                                                                                                                                 ans += areaCT(c.r, u - c.0, v - c.0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 vector<P> pts=insCC(c[i],c[j]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         evt.pb(E(pts[0],a[0],1));
evt.pb(E(pts[1],a[1],-1));
                                                                                                                                                                                                                                                                                                                                                                                             P u = p[i], v = p[(i + 1) % n];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   namespace CircleIntersection{ // ?
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      cnt += a[0] > a[1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  cnt+=evt[j].delta;
                                                                                                                                                                                                                                                                        db areaCPoly(C c, vector<P> p) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   void solve(C *c,int n,T *ans)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         evt.pb(evt.front());
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   rep(j, 0, sz(evt)-1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(j,0,n) if(j!=i){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      sort(all(evt));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if(sz(pts)) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       return fabs(ans) / 2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               vector<E> evt;
                                                                                                                                                                                                               }
// 【圆与多边形交面积】
                                                                                                                                                                                return det(s, t);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int cnt=1;
                                                                                                                                                                                                                                                                                                                                                                    rep(i, 0, n) {
if(b1 && b2) {
                                                                                                                                                                                                                                                                                                           int n = sz(p);
                                                                                                                                                                                                                                                                                                                                     db ans = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    struct E{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  / 【國交】
```

```
bool b1 = sign(s.len2() - r * r) == 1, b2 = sign(t.len2() - r * r) == 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   P p = l.a - ((1.b - 1.a) * (x / y)), det = (1.b - 1.a) * (sqrt(d) / y); p1 = p - det, p2 = p + det; // dir : l.a \rightarrow l.b
                          res.pb(c1.0 + (c2.0 - c1.0) * c1.r / (c1.r + c2.r));
                                                                                                                     res.pb(c1.0 + (c2.0 - c1.0) * c1.r / (c1.r - c2.r));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                P p = (c1.0 * -c2.r + c2.0 * c1.r) / (c1.r - c2.r);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if(tanCP(c1, p, p1, p2) && tanCP(c2, p, q1, q2)) {
  if(c1.r < c2.r) swap(p1, p2), swap(q1, q2);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   db x = dot(1.a - a.o, 1.b - 1.a);
db y = (1.b - 1.a).len2();
db d = x * x - y * ((1.a - a.o).len2() - a.r * a.r);
if(sign(d) < 0) return 0;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if(tanCP(c1, p, p1, p2) && tanCP(c2, p, q1, q2)) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      P p = (c1.0 * c2.r + c2.0 * c1.r) / (c1.r + c2.r);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               bool f = iscL(C(P(0, 0), r), L(s, t), p1, p2);
if(!f) return r * r * rad(s, t);
                                                                                                                                                                                                                                                                                                                                                                                                      dir = (dir * (c1.r / dir.len())).rot90();
                                                                                                                                                                                                                                                                                                                                                                                                                                     ret.pb(L(c1.0 + dir, c2.0 + dir));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                    ret.pb(L(c1.0 - dir, c2.0 - dir))
if(sign(dis - (c1.r + c2.r)) == 0)  {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     areaCT(db r,P s,P t) { // 需要除
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         bool isCL(0 a, L l, P &p1, P &p2) {
                                                                                          if(sign(dis - fabs(c1.r - c2.r))
                                                                                                                                                                                                                                                                            vector<L> extanCC(C c1, C c2) {
                                                                                                                                                                                                                                                                                                                                          if(sign(c1.r - c2.r) == 0) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               vector<L> intanCC(C c1, C c2) \{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ret.pb(L(p1, q1));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           ret.pb(L(p2, q2));
                                                                                                                                                                                                                                                                                                                                                                         P \text{ dir} = c2.0 - c1.0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                ret.pb(L(p2, q2));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   ret.pb(L(p1, q1));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               p1, p2, q1, q2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         // 【 國与三角形交面积】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       P p1, p2, q1, q2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                d = max(d, 0.);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       // 【直线和圆求交】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              vector<L> ret;
                                                                                                                                                                                                                                                                                                               vector<L> ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return ret;
                                                                                                                                                                                          return res
                                                                                                                                                                                                                                                 // 【外公切线】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           // 【内公切线】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     } else {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return 1;
```

```
5.7 7, 3D
```

```
void convexCut(vector<P> &p, L l) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    HalfPlane_nlogn
                                                                                                                                                                                                                                                                                                                                                                                                                                        void convexCut(vector<P> &p,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if(d1 >= 0) q.pb(p1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  } else if(sign(b)==0)
                                                                                                                                           HalfPlane n2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if(sign(c)!=0) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if(sign(a)==0)
                                                                                                                                                                                        // 1: a->b 逆时针方向
                                                                                                                                                                                                                                                                                                                                                                                                                    // ax + by + c >= 0
                                                                            Mat r; rep(i, 0,
                                                                                                                                                                                                                                vector<P> q;
                                                                                                                                                                                                                                                                                                                                                                                                                                                             vector<P> q
                                                                                                                                                                                                                                                                                                                                                                           p = q
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                struct L {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      struct P {
                                                                                                                                           .
დ
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    5.9
                                                                                                                                                                                                                                                                                                                                                                                                                                                                      rep(i, 0, 4) rep(j, 0, 4) rep(k, 0, 4) r.a[i][j] += a[i][k] * c.a[k][j];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                Mat r; rep(i, 0, 4) rep(j, 0, 4) r.a[i][j] = p[i][j]; return r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              4) rep(j, 0, 4) r.a[i][j] = p[i][j]; return r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     db ty, db tz) { // 平移,以下矩阵均为左乘
                                                                                                                                                                                                                                                                                                                                                                                    void set() { rep(i, 0, 4) rep(j, 0, 4) a[i][j] = 0; }
void e() { rep(i, 0, 4) a[i][i] = 1; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  Mat rotate(P3 s, db a) { // 绕 s 为轴旋转 a 度, 右手方向
                                                        db t = 1; P3 ans(0, 0, 0);
rep(i, 0, n) ans = ans + p[i]; ans = ans / n;
                                                                                                                                                                                  if(ret < tmp) ret = tmp, j = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    Mat scale(db a, db b, db c) { // 缩放
db p[4][4] = {
                                                                                                                                                            db tmp = (p[i] - ans).len();
                                                                                                                                                                                                                         ans = ans + (p[j] - ans) * t;
                                                                                                                                                                                                                                                                                                                                                                                                                                Mat operator * (const Mat &c)
                  P3 MinSphere(vector<P3> p) {
                                                                                                  while(t > eps) {
  int j = -1; db ret = -1;
                                       int n = sz(p); assert(n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       Mat kpow(Mat a, int b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if(b & 1) r = r * a;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            Mat r; r.set(); r.e();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       Mat translate(db tx,
                                                                                                                                                                                                                                                                                                                                                                                                                                                  Mat r; r.set();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              Mat r; rep(i, 0,
                                                                                                                                                                                                                                                                                                                          // 【三维向量变换】
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              1, 0, 0, tx,
0, 1, 0, ty,
0, 0, 1, tz,
0, 0, 0, 1};
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           rep(i, 0, n)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             db p[4][4] = {
【最小球覆盖】
                                                                                                                                                                                                                                              t^* = 0.999
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   a = a * a;
                                                                                                                                                                                                                                                                                                                                                                     db a[4][4];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return r;
                                                                                                                                                                                                                                                                                      return ans;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        while(b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            b >>= 1;
                                                                                                                                                                                                                                                                                                                                                  struct Mat {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 return r;
```

```
db 1 = s.len(), x = s.x / 1, y = s.y / 1, z = s.z / 1, si = sin(a), co = cos(a);
db p[4][4] = {
    co + (1 - co) * x * x, (1 - co) * x * y - si * z, (1 - co) * x * z + si * y, 0,
    (1 - co) * y * x + si * z, co + (1 - co) * y * y, (1 - co) * y * z - si * x, 0,
    (1 - co) * z * x - si * y, (1 - co) * z * y + si * x, co + (1 - co) * z * z, 0,
    0, 0, 0, 1};
Mat r; rep(i, 0, 4) rep(j, 0, 4) r.a[i][j] = p[i][j]; return r;
```

```
while(cur <= (tmp = area(p[i], p[j], p[(k + 1) % n]))) (++k) %= n, cur = tmp; if(cur <= (tmp = area(p[i], p[(j + 1) % n], p[k]))) (++j) %= n, cur = tmp;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                for (int 1 : vals) area += 1d(1) * sqrt(1d(D) * 1d(D) - 1d(1) * 1d(1)) / 4; 1d hiArea = 1d(hi) * sqrt(1d(D) * 1d(D) - 1d(hi) * 1d(hi)) / 4;
                                                                                                                                                                                                                                                               while (tooSmall(ma)) numExpand++, ma += (ma - mi);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         P &b, P &c) {
                                                               ld hiAng = 2 * asin(ld(hi) / ld(D));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                tmb;
                                                                                                                               else return ang + hiAng >= 2 * PI;
                                                                                            if (isReflex) return ang < hiAng;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        T res = area(a, b, c), cur = res,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    void maxAreaTri(P *p, int n, P &a,
int i = 0, j = 1, k = 2;
a = p[i], b = p[j], c = p[k];
                                                                                                                                                                                                                                                                                                rep(tim, 0, 50 + numExpand) { Id md = mi + (ma - mi) / 2;
                                                                                                                                                                                                                                                                                                                                                              if (tooSmall(md)) mi = md;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if (isReflex) area —= hiArea;
auto tooSmall = [\&](ld D)
                                                                                                                                                                                               Id mi = hi, ma = hi + 1;
                                 ld ang = getAngle(D);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              MaxAreaTri
                                                                                                                                                                                                                                                                                                                                                                                                                                                                 Id D = mi, area = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      else area += hiArea;
                                                                                                                                                                                                                                   int numExpand = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 else break;
                                                                                                                                                                                                                                                                                                                                                                                                       else ma = md;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          while(1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          return area;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             // 0(n ^ 2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              5.11
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    bool includer(const P &p) const { return sign(det(b - a, p - a)) > 0; bool include(const P &p) const { return sign(det(b - a, p - a)) >= 0; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     while(sz(q) > 2 && !check(q[sz(q) - 2], q.back(), q[0])) q.pop_back();
while(sz(q) > 2 && !check(q[1], q[0], q.back())) q.pop_front();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  while(sz(q) > 1 && !check(q[1], q[0], 1[1])) q.pop_front();
q.pb(1[1]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    bool check(L u, L v, L w) { return w.include(isLL(u, v)); }
                                                                                                                                                                                                                                                                                                                                                                                                  return sign(det(a, b)) == 0 \& sign(dot(a, b)) == 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if(a.quad() != b.quad()) return a.quad() < b.quad();
return sign(det(a, b)) > 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 bool operator < (const L &l0, const L &l1) {
   if(sameDir(l0, l1)) return l1.includer(l0.a);
   return (l0.b - l0.a) < (l1.b - l1.a);</pre>
                                                                                                                                                                                                  P det = (b - a).rot90().norm() * len;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                 bool operator < (const P &a, const P &b)
                                                                                                                                                                                                                                                                                                                                  bool sameDir(L 10, L 11) {
   P a = 10.a - 10.b, b = 11.a - 11.b;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  deque<L> halfPlane(vector<L> 1) {
                                                                                                                                                                                                                                return L(a + det, b + det);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    sort(all(l)); dequeL> q;
                                                                                                                                  // 向内(右手方向)推
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       rep(i, 0, sz(l)) {
                                                                                                                                                                   L push(db len) {
```

if(cur > res) a = p[i], b = p[i], c = p[k], res = cur;cur = area(p[i], p[j], p[k]); if(i == j) (++j) %= n; if(j == k) (++k) %= n; (++i) %= n; } while(i);

MinAreaTri 5.12

```
bool cmp(const P &x, const P &y) { return det(x, y) < \theta; }
                                                       struct P { int x, y, ind, u, v; };
                                                                                                                                   const 11 inf = 4e18;
                                                                                  namespace MinAreaTri {
                                                                                                            const int N = 2020;
                                                                                                                                                                int n, m, pos[N];
                                                                                                                                                                                        P p[N], 1[N * N];
// 无重点、三点共线
                              // 0(n^2 10g_2n)
```

for (**int** 1 : vals) tot += 2 * asin(ld(1) / ld(D));

auto getAngle = $[\&](ld D) \rightarrow ld\{$

ld tot = 0; return tot;

if (sum <= hi) return 0;

vals.pb(cur); sum += cur;

if (cur > hi) swap(cur, hi);

rep(i, 1, sz(S)) { **int** cur = S[i];

MaxAreaPoly

5.10

int sum = 0, hi = S[0];

vi vals;

solve_poly(vi &S) { assert(sz(S) > 0);

19

};
bool isReflex = (getAngle(hi) < PI);</pre>

5.15 平面图转对偶图

凹四边形计数

5.13

```
static const int N = 101010, M = 101010
                                                                                                                                                                                                                                                                                                           rep(i, 0, sz(ps)) g[i].clear();
                                                                                                                                                                                                                                                                                                                                 fill_n(vis, cnte, false);
ps.clear(); cnte = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                          void adde(int u, int v)
                                                                                                                                                                                                                                                                                                                                                                                                                                                     g[u].pb(mp(v, cnte));
E[cnte++] = mp(u, v);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 g[v].pb(mp(u, cnte));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         \mathsf{E}[\mathsf{cnte++}] = \mathsf{mp}(\mathsf{v}, \mathsf{u});
                                               // ps id starts from 0
                                                                                            // cnte id starts from
                                                                                                                                                                                                                                                                                                                                                                                  areas.clear();
                                                                                                                                                                   // u -> (v, cnte)
                                                                                                                                                                                                                                        vector<db> areas;
                                                                                                                                                                                         vector<pii> g[N];
                                                                                                                  int cnte, ne[M];
                                                                                                                                                                                                                                                                                void init() {
                                                                      vector<P> ps;
                                                                                                                                      bool vis[M];
struct Planar {
                                                                                                                                                                                                               pii E[M];
```

```
== 0 && a.x >= 0); }
                                                                                                                                                                                                                                                                                                                                                                                                                                     while(j >= 2 && det(q[j], q[i]) > 0) — j, ++cnt;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          *111 * (c - k - 1);
                                                                                                                                                                                                                                                                     rep(i, 1, n + 1) q[i] = p[i]; swap(q[1], q[u]); rep(i, 2, n + 1) q[i] = q[i] - p[u];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   int c = j = k + 1;
rep(i, 2, k + 1) {
   while(c <= n && det(q[i], q[c]) > 0) ++c;
while(j <= n && det(q[i], q[j]) >= 0) ++j;
ans += s[j] + (n - j + 1) * 111 * (c - k -
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            ll ans = 0; rep(i, 1, n + 1) solve(i, ans);
                                                                                                                                                                                                                                                                                                                                                       int k = n; while(k >= 2 \&\& q[k].y <= 0)
                                                                       bool gao(P a) { return a.y > 0 || (a.y bool cmp(P a, P b) {
                                                                                                                                  bool o = gao(a), t = gao(b);
if(o != t) return o > t;
                                                                                                                                                                                                                                                                                                                         sort(q + 2, q + n + 1, cmp);
                                                                                                                                                                                                                                           void solve(int u, ll &ans) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                  s[i] = s[i + 1] + cnt;
                                                                                                                                                                                                                                                                                                                                                                                                            per(i, k + 1, n + 1) {
                     int n; P p[N], q[N]; 11 s[N];
namespace CNT {
                                                                                                                                                                                       return det(a, b) > 0;
                                                                                                                                                                                                                                                                                                                                                                                    int j = k, cnt = 0;
const int N = 1010;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     }
11 solve() {
```

-1; }

 $a = a \ll 1 \mid va; b = b \ll 1 \mid vb;$ g[a].pb(b); g[b ^ 1].pb(a ^ 1);

addedge(a, va ^ 1, b, vb);

addedge(a, va, b, vb); addedge(b, vb, a, va)

2

```
else ans = min(ans, disSS(L(p[o], p[(o + 1) % n]), L(q[t], q[(t + 1) % m])));
                                                                                                                                                                                                                                                                                                                                                                                                                  while(det(t, ps[(p + 1) % n] - ps[p]) > 0) (++p) %= n, while(dot(t, ps[(1 + 1) % n] - ps[1]) < 0) (++1) %= n,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         while(dot(t, ps[(r + 1) % n] - ps[r]) > 0) (++r) %= n;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      11 et = abs(det(ps[p], ps[i], ps[(i + 1) % n]));
11 ot = abs(dot(t, ps[1] - ps[r]));
                                                                                                                                                                                p, n));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                ans = min(ans, (db)et * ot / t.len2());
                                                                                                                                                                             return min(solve(p, n, q, m), solve(q, m,
                                                                                                                                                work(P p[], int n, P q[], int m) {
                                                                                                                                                                                                                                                                                                                           int p = 1, l = 1, r;
rep(i, 0, n) {
  P t = ps[i] - ps[(i + 1) % n];
                                                                                                                                                                                                                                                                                                int n = sz(ps); T ans = 1e18;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  // 【凸包最小周长外接矩形】
                                                                                                                                                                                                                                    // 【凸包最小面积外接矩形】
                                                                                                                                                                                                                                                                      T solve(vector<P> ps) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                           r = (p + 1) \% n;
                                :u =% (0++)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         Graph
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                return ans;
                                                                                         return ans;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           ဗ
                                                                                                                                                                                                                                                                                                                                                                                                                                                void solve(const vector<P> &_ps, const vector<pii> init(); ps = _ps;
                                                                                                                                                                                                                                                                                             res += det(ps[E[e].se], ps[E[e].fi]); vis[e] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(j, 0, sz(g[i])) {
ne[g[i][j].se] = g[i][(j + 1) % sz(g[i])].se;
                                                         P a = ps[i.fi] - ps[V], b = ps[i.fi] - ps[V];
int o = P(0, 0) < a, t = P(0, 0) < b;
                             bool cmp(const pii &i, const pii &j) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         for(auto e : es) adde(e.fi, e.se);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(i, 0, cnte) if(!vis[i]) go(i);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      rep(i, 0, sz(ps)) {
    V = i; sort(all(g[i]), cmp);
                                                                                                                                                                                                                                                                                                                                                                                      if(res > 0) areas.pb(res / 2);
                                                                                                                  if(0 != t) return 0 < t;
                                                                                                                                                  return det(a, b) > 0;
                                                                                                                                                                                                                                                                      while(!vis[e]) {
                                                                                                                                                                                                                                                                                                                                e = ne[e \wedge 1]
                                                                                                                                                                                                      void go(int e) {
                                                                                                                                                                                                                                    db res = 0;
```

```
2-sat
```

```
void add_set(int a, int va) { a = a << 1 | va; g[a ^ 1].pb(a); } // va 必选
void add_then(int a, int va, int b, int vb) { // va 和 vb 不能同时取
addedge(a, va, b, vb ^ 1);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     void add_xor(int a, int va, int b, int vb) { // va 和 vb 同时取或同时不取
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            void add_or (int a, int va, int b, int vb) { // va 和 vb 不能同时不取
                                                                                                                                                                                                                                                                                                                                                      void addedge(int a, int va, int b, int vb) { // va 选了 vb 必选
                                                                                                                                                                                                                                                             void init(int _n) { per(i, 0, (n = _n << 1)) g[i].clear(); }
int new_node() { rep(i, 0, 2) g[n++].clear(); return n / 2 -
/// optionals begin</pre>
                                                                                                                                                                   int dfn[N], low[N], id[N], st[N], _st,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     }
// 需要 sz(vu) 个额外的 dp 变量
                                                                                                                                       static const int N = ::N << 1
                                                                                                                                                                                                                                int mark[N], n;
                                                                                                          struct TwoSat
                                                                                                                                                                                                     vi g[N];
                               6.1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 while((tmp = det(a, q[(t + 1) % m] - q[t])) < 0) (++t) %= m; 
if(sign(tmp)) ans = min(ans, disToSeg(L(p[o], p[(o + 1) % n]), q[t]));
                                                                                                                                                                                                                                                                                                                         while(\det(t, ps[(p + 1) % n] - ps[p]) > 0) (++p) % = n;
                                                                                                                                                                                                                                                                                                                                                                                        ans = max(ans, (ps[(i + 1) % n] – ps[p]).len());
                                                                                                                                                                                                                                                                                                                                                      ans = max(ans, (ps[i] - ps[p]).len());
                                                                                                                                                                                                   if(n <= 1) return 0;
if(n == 2) return (ps[1] - ps[0]).len();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 P a = p[(o + 1) % n] - p[o]; db tmp;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int o = 0, t = 0; T ans = inf;
rep(i, 1, n) if(p[i].y > p[o].y) o = i;
rep(i, 1, m) if(q[i].y < q[t].y) t = i;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         T solve(P p[], int n, P q[], int m) {
                                                                                                                                                                                                                                                                                          P t = ps[i] - ps[(i + 1) % n];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       1
                                                                                                                             T diameter(vector<P> ps)
                                                                                                                                                               n = sz(ps); T ans = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             凸包间的最大距离】点
                                                                                                     // 【凸包直径】点 − 点
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          【凸包间的最小距离】
                                                                        // 凸包都是顺时针给出
旋转卡壳
                                                                                                                                                                                                                                                               rep(i, 0, n) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            rep(i, 0, n) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              【凸包宽度】点
                                                                                                                                                                                                                                                                                                                                                                                                                                                         return ans;
    5.16
```

```
if (!dfs(i ^ 1)) return 0;
}
return 1;
```

6.2 BCC

```
rep(i, 0, n) if(!dfn[i]) dfs(i, 1, g);
rep(i, 0, n) for(auto j:g[i]) if(id[i]!=id[j.fi])
bcc[id[i]].pb(id[j.fi]);
                                                                                                                                                                                                                                                                                                                                               low[c]=min(low[c],low[t]);
if(low[t]>dfn[c]) key.pb(e.se);
} else if(dfn[t] != dfn[c] - 1 || cc++)
                                                                                                                                 int dfn[N] , low[N] , id[N] , st[N] , _st , _;
void dfs(int c,int dep,vector<pii> g[]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           do{id[st[---st]]=_;}while(st[_st]!=c);
                                                                                                                                                                                                                                                                                                                                                                                                                           low[c] = min(low[c], dfn[t]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int solve(int n, vector<pii> g[]){
// key contains the id of edges
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                fill_n(bcc, n, key=vi());
                                                                                                                                                                                                                                                                                                                        dfs(t, dep+1, g);
                                                                                                                                                                                      int cc=0;st[_st++]=c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       fill_n(low,n,_st=0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if(low[c]==dfn[c]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            fill_n(dfn,n,_=0);
                                                                                                                                                                                                             dfn[c]=low[c]=dep;
                                                                                                                                                                                                                                          for(auto e:g[c]){
                                                                            const int N = 202020;
                                                                                                                                                                                                                                                                                         if(!dfn[t]){
                                                                                                                                                                                                                                                                     int t=e.fi;
                                                                                                      vi key, bcc[N];
                            // _ starts from 0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          return _;
                                                     namespace BCC{
```

```
6.3 CircleCount
```

```
11 f[N][5], du[N], D[N], cnt4[N], cnt3[N], cnt1[N], t, ans;
                                                                                                            // cnt3,4 中为包含 i 号点的三, 四元环数量
                                 static const int N = 1e5 + 7;
                                                                                                                                                                       priority_queue<pii> q;
vi w[N], gg[N], d2, d1;
                                                           int n, m, u, v, x, y;
                                                                                                                                                                                                                                set<int> g[N];
      struct circle4 {
                                                                                         bool vis[N];
                                                                                                                                                                                        if (!dfs(i)) {
    rep(j, 0, tot) col[ans[j]] = col[ans[j] ^ 1] = 0;
                                                                                                       bool solve2() { // 构造字典序最小解
for (int i = 0; i < n; i += 2) if (!col[i])
col[u] = 1; col[u \land 1] = -1;
for (auto v : g[u]) if (!dfs(v)) return 0;
                                                           return 0;
```

```
if(!dfn[t]) dfs(t, g), low[c] = min(low[c], low[t]);
else if(!id[t]) low[c] = min(low[c], dfn[t]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    do{id[st[--st]]=_;}while(st[_st] != c);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if (id[i] == id[i + 1]) return 0;
mark[i >> 1] = (id[i] > id[i + 1]);
void add_at_most_one(vector<pii> vu) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    rep(i, 0, n) if(!dfn[i]) dfs(i, g);
                                            rep(i, 0, sz(vu)) {
    int a = vu[i].fi, va = vu[i].se;
                                                                                                                                                                                        addedge(pre, 1, a, va \wedge 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    for (int i = 0; i < n; i += 2) {
                                                                                                                                                                  addedge(pre, 1, dpi, 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if (col[u] == -1) return 0;
if (col[u] == 1) return 1;
                                                                                                                     addedge(a, va, dpi, 1);
                                                                                               int dpi = new_node();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   bool solve() { // 构造任意解
                                                                                                                                                                                                                                                                                                                                                          dfn[c] = low[c] = ++cc;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       fill_n(low, n, _st=0);
                                                                                                                                                                                                                                                                                                                                        void dfs(int c, vi g[]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if(low[c] == dfn[c]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             fill_n(dfn, n, cc=0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int col[N], ans[N], tot;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(i, 0, n) —id[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                fill_n(id, n, _=0);
                                                                                                                                                                                                                                                                                                                                                                                                           for(auto t : g[c])
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    ans[tot++] = u;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         bool dfs(int u) {
                                                                                                                                                                                                                                                                                                                                                                                      st[\_st++] = c;
                                                                                                                                                                                                                                                                                                               // optionals end
                          int pre = -1;
                                                                                                                                                                                                                                          pre = dpi;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       void find(){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   return 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             find();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        return;
```

```
for(auto j : g[i]) if(dp[j.se] > md) md = dp[j.se], ne[0][i] = j.se, col = j.fi
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            per(i, 0, M) if(ne[i][u] && cnt[i][u] < k && k <= cnt[i][u] + dp[ne[i][u]]) {
                                                                                                                                                                                                                                                                                                                                                                                     pre[i][j] = (j == 0 ? sp[i] : pre[i][j - 1]) + dp[t.se];
if(t.fi < col) cnt[0][i] = min((11)lim, cnt[0][i] + dp[t.se]);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       // can handle isolate point and not connected graph and muti edge
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        cn\bar{t}[\bar{i}][\bar{j}] = m\bar{i}n((l1)\bar{l}i\bar{m}, cnt[i-1][j] + cnt[i-1][t]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int p = lower_bound(all(pre[u]), k) - pre[u].begin(); k -= (p == 0 ? sp[u] : pre[u][p - 1]);
                                                                                                                                                                                                                                                                                              cnt[0][i] = sp[i]; pre[i] = vector<11>(sz(g[i]));
rep(j, 0, sz(pre[i])) {
    pii t = g[i][j];
                                                                                      int ne[M][N]; ll cnt[M][N]; vector<ll> pre[N];
                                                                                                                                                                               const int N = ::N, M = 18, lim = 1e9;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     // dcc i->j , i(points) , j(bcc_block)
// st is stack
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 1, M) rep(j, 1, n + 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if(k == 1 && sp[u]) break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  ne[i][j] = ne[i - 1][t];
                                                    bool sp[N]; 11 dp[N]; // init
                                                                                                                                                 void build(vector<pii> g[]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int t = ne[i - 1][j]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       // can handle self circle ?
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     k = cnt[i][u];

u = ne[i][u];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   int ans = 0, u = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            ans += pw(i);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  u = g[u][p].se;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            // _st is top of stack
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              // cactus: n multi by
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         _ is number of dcc
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        int qry(int k) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            while(1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return ans
  namespace DAG {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       // key is cuts
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  ++ans
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  namespace DCC{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          DCC
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            6.5
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 ans == 2 * cnt3[i] * D[i]; for (auto v : gg[i]) ans == (D[v] - 1) * D[v]; //第一次重复为第 2 步
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      for (auto v : gg[i]) ans3 -= D[v] \dot{} i, ans \dot{} = ans3; // 边数为 3 的链数 for (auto v : gg[i]) ans -= 2 * cnt3[v]; ans += 4 * cnt3[i];
                                                                                                                                                                                                                                                                                                                                                                                                                  rep(i, 1, 5) rep(j, 1, n+1) for (auto v : gg[j]) f[j][i] += f[v][i-1];
while (!q.empty()) {
    x = q.top().se; y = q.top().fi; q.pop();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             ans -= cnt4[i] * 2; 11 ans3 = f[i][3] - D[i] * D[i] - 2 * cnt3[i]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                for(auto u : d1) vis[u] = 0; d1.clear(); d2.clear();
                                                                                                                                                                                                   D[i] = du[i] = sz(gg[i]); cnt3[i] = cnt4[i] = 0;
for (auto v : gg[i]) g[i].insert(v);
                                                                                 for (auto v : g[u]) if (v != fa) dfs(v, d+1, u);
void dfs(int u, int d, int fa) {
   if (d == 2) { d2.pb(u); w[u].pb(fa); return; }
   if (d == 1) d1.pb(u), vis[u] = 1;
                                                                                                                                                                                                                                                                                                                                              rt, ±, ...±, r
rep(j, 1, 5) f[i][j] = 0; f[i][0] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               rep(i, 1, n+1) { // 计算边数为 4 的链数
ans = f[i][4];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if (vis[u]) cnt3[v]++, t++;
                                                                                                                                                                                                                                                                                                rep(i, 1, n+1) q.push(mp(du[i], i));
rep(i, 1, n+1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            cnt4[x] += s * (s - 1) / 2;

cnt4[u] += s * (s - 1) / 2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         d.push(mp(——du[u], u));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if (du[x] != y) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         //以第一次产生重复位置分类计数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              cnt3[x] += t / 2; t = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             for (auto v : w[u]) {
                                                                                                                                               void solve(int n, vi gg[]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             cnt4[v] += s - 1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           for (auto u : g[x]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            ans -= D[i] * f[i][2];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               //第一次重复为第 4 步
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 //第一次重复为第3步
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         dfs(x, 0, -1);
for (auto u : d2) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    11 s = sz(w[u]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    g[u].erase(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            w[u].clear();
                                                                                                                                                                                   rep(i, 1, n+1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       cnt1[i] = ans;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                } c4;
```

6.4 DAG 韵分

vi key , dcc[N];
int dfn[N] , low[N] , st[N] , _st , _;

const int N = 202020;

```
int p = ans[i], x = pos[p].fi.fi, y = pos[p].fi.se, c = pos[p].se;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(j, 1, len+1) {
   if (ss[i][j-1] == '-') rep(k, 1, len+1) ins(i, j, k);
                                                                                                                                                                                                                                                                                                                                     //cout << ans[i] << " \n"[i == ansd - 1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           else ins(i, j, ss[i][j-1] - 'A' + 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            rep(i, 1, len+1) cout << ss[i] << endl;
                                                                                              FOR(i, r, 0) if (s[c] > s[i]) c = i;
                                                             Η
                                                                                                                                                                                                                  FOR(j, l, i) restore(col[j]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       SS[X][y - 1] = C + 'A'
                                                                                                                                                                              FOR(j, r, i) remove(col[j]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           n = 0; init(len * len * 4);
rep(i, 1, len+1) {
   if (i > 1) cin >> ss[i];
                                                                                                                                                                                                if (dance(dep+1)) return 1;
                                                        if (!r[0]) return ansd = dep,
                                                                                                                                                                                                                                                                                                                   void ins(int x, int y, int c) {
   ပ်
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             rep(i, 1, ansd) {
1[r[c]] = c; r[1[c]] =
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         while (cin >> ss[1]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       bool ok = dance(1);
                                                                                                                                    FOR(i, d, c) {
 ans[dep] = row[i];
                                                                                                                                                                                                                                                          restore(c); return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   cout << endl;
                                    bool dance(int dep) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     tmp.resize(4);
                                                                            int c = r[0];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if (ok) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                              add(n, tmp);
                                                                                                                     remove(c);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 void work() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    DMST
                                                                                                                                                                                                                                                                                                vi tmp;
```

static const int N = 2e4 + 8, D = 4, len = 16;
int n, m, tim, ansd, row[N], col[N], s[N], ans[N], l[N], r[N], u[N], d[N];
pair<pii, int> pos[N]; string ss[100];

#define FOR(i, ne, t) for(int i = ne[t]; i != t; i = ne[i])

while(st[--_st]!=t) dcc[st[_st]].pb(_);
dcc[c].pb(_);dcc[t].pb(_++);

if(++out==2) key.pb(c);

low[c]=min(low[c],low[t]);

dfs(t,dep+1,g);

if(low[t]>=dfn[c]){

void dfs(int c,int dep,const vi g[]){ int cc=0, out=1<dep; st[_st++]=c;</pre>

dfn[c]=low[c]=dep; if(!dfn[t]){ for(auto t:g[c])

int solve(int n, const vi g[]){// n is size of points

} else if(dfn[t] != dfn[c] - 1 || cc++) $low[c] = min(low[c]^{'}, dfn[t]);$ rep(i,0,n) **if**(sz(dcc[i]) == 0) dcc[i].pb(_++),

return _;

DLX

6.6

struct DLX{

rep(i,0,n) **if**(!dfn[i]) dfs(i,1,g);

fill_n(dcc, n, key=vi());

fill_n(low,n,_st=0);

fill_n(dfn,n,_=0);

rep(i, 0, m+1) l[i] = i-1, r[i] = i+1, u[i] = d[i] = i; l[0] = m, r[m] = 0, tim = m+1;

void init(int _m) {

void add(int R, const vi &tmp){

int first = tim;

rep(i, 0, sz(tmp)) {
 int c = tmp[i];

rep(i, 0, m+1) s[i] = 0;

```
struct edge {int u, v, d, U, V;bitset<1005> b;};
                                                                                                                                                                                                                                                                              // can handle multi edge,
                                                                                                                                                                                                                                                // id starts from 0
                                                                                                                                        inline void remove(int c) {
    l[r[c]] = l[c]; r[l[c]] = r[c];
    FOR(i, d, c) FOR(j, r, i) u[d[j]] = u[j], d[u[j]] = d[j], --s[col[j]];
                                                                                                                                                                                                                                                                                                                    FOR(i, u, c) FOR(j, l, i) u[d[j]] = j, d[u[j]] = j, ++s[col[j]]
                                                                    if (sz(tmp)) 1[first] = tim-1, r[tim-1] = first;
                                                                                                                                                                                                                                                                                 inline void restore(int c) {
tim++, s[c]++;
```

l[tim] = tim-1, r[tim] = tim+1, u[tim] = u[c], d[tim] = c;

u[c] = tim; d[u[tim]] = tim;row[tim] = R, col[tim] = C; self ring

if (~mins[v] && dfn[sem[mins[v]]] < dfn[sem[mins[u]]]) mins[u] = mins[v];

fs[u] = find(fs[u]);

return fs[u];

int s , t , n , h[N] , cur[N] , 1v[N] , q[N] , e , ne[M] , to[M];
T cap[M] , flow;

const static int N = 10101 , M = N * 10;

```
/oid liu(int u,int v,T w){ to[e] = v;ne[e] = h[u];cap[e] = w;h[u] = e++;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  T flow = dfs(to[k] , min(mx , cap[k])); ret += flow;cap[k] -= flow , cap[k^1] += flow;mx -= flow;
                       void link(int u,int v,T w){ liu(u , v , w);liu(v , u , \bar{0});}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          vis[u] = stamp; dfn[u] = sz(ord); ord.pb(u);

for (auto v : g[u]) if (vis[v] != stamp) fa[v] = u, dfs(v);
                                                  void ini(int _{-}n = N) { fill(h , h + (n=_n) , -1);e = 0;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       if(1v[to[k]] == 1v[c] + 1 \&\& cap[k] > 0)
                                                                                                                                                                                                                                         for(int k = h[c]; -k ; k = ne[k])
if(cap[k] > 0 && !~lv[to[k]])
lv[q[R++] = to[k]] = lv[c] + 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for(int \&k = cur[c]; ~k; k = ne[k]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int fs[N], mins[N], dom[N], sem[N], buf2[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if(!mx) return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                flow += dfs(s, ~0U>>1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     copy(h, h + n, cur);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              vi revg[N], g[N], buf[N], ord;
int stamp, vis[N], dfn[N], fa[N];
                                                                                                                                  fill(lv , lv + n , -1);
lv[q[R++] = s] = 0;
while(L < R && !~lv[t]){
                                                                                                                                                                                                                                                                                                                                                                                                                                       if(c == t) return mx;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       if (u == fs[u]) return u;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            DominatorTree
                                                                                                         int L = 0, R = 0;
                                                                                                                                                                                                                  int c = q[L++]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       T run(int _s,int _t){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     S = \_S, t = \_t;
f1Ow = 0;
                                                                                                                                                                                                                                                                                                                                                         return ~lv[t];
                                                                                                                                                                                                                                                                                                                                                                                                                T dfs(int c,T mx){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       while(bfs()){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         const int N = 1e5 + 7
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     return flow;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       [v[c] = -1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                    T ret = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     void dfs(int u) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int find(int u) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int v = fs[\bar{u}];
                                                                           bool bfs(){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            6.9
                                                                                                                                                                    II
                                                                                                                                      void ini(int n) {this->n = n, m = 0;}
void addedge(int u, int v, int d) {e[m] = edge({u, v, d, u, v}); e[m].reset();e[m].b[m]
                                                                                                                                                                                                                                                                                                                                                                                  if(e[i].d < in[v] && u != v) in[v] = e[i].d, pre[v] = u, index[v] = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                while(vis[v] != i && id[v] == -1 && v!=root) vis[v] = i, v = pre[v];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   e[i].u = id[e[i].u]; e[i].v = id[e[i].v];
if(e[i].u != e[i].v) {e[i].d -= in[v];e[i].b ^= e[index[v]].b;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if(v != root && id[v] == -1) {
   for(int u=pre[v];u != v;u = pre[u]) id[u] = cnt;
                                                    edge e[M];int n, m, vis[N], pre[N], id[N], index[N], Pre[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     rep(i, 0, n) if(id[i] == -1) id[i] = cnt++;
                           static const int N = ::N, M = N * N, inf = 2e9;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     memset(vis, -1, sizeof(*vis)*n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if(in[i] == inf) return -1;
                                                                                                                                                                                                                                                                                                                                                       int u = e[i].u, v = e[i].v;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       memset(id, -1, sizeof(*id)*n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     ans += in[i]; int v= i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if(i == root) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           fang \wedge = e[index[i]].b;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int cnt = 0;in[root] = 0;
                                                                                                                                                                                                                                                                                              rep(i, 0, n) in[i] = inf;
rep(i, 0, m){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         n = cnt; root = id[root];
                                                                                                                                  void ini(int n) {this->n = n,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                int t = index[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                id[v] = cnt++;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if(cnt == 0) break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int v=e[i].v;
                                                                                                                                                                                                                                                                                                                                                                                                                                       rep(i, 0, n) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 rep(i, 0, m) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(i, 0, n){
                                                                                                                                                                                                                  int run(int root){
                                                                             bitset<1005> fang;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                // double need eps
                                                                                                                                                                                                                                                  int ans = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         template<class T>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              return ans;
                                                                                                                                                                                                                                                                         while(1){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  // [0,n) init!!
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     Dinic
                                                                                                           int in[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                struct Dinic
  struct DMST{
                                                                                                                                                                                               1;m++;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     dmst;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       6.8
```

```
if (sz(cir[k]) > 1 && ne[cir[k][0]] != cir[k][1]) reverse(all(cir[k]));
                                                                                                                                                                                                                                                                                                               if (!dfn[v]) {fa[v] = u; d[v] = d[u] + w; dfs(v, g[u][i].se);}
                                                                                                   int p = u; cir[k].pb(p); id[p] = k;
if (p != v) {do { p = fa[p]; cir[k].pb(p); id[p] = k;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         static const int N = 1e5 + 100, M = 17; // (1 << M) > n
int v = g[u][i].fi.fi, w = g[u][i].fi.se;
                                  if (dfn[v] && dfn[v] <= dfn[u]) .
                                                                                                                                                                                                                                                                                                                                                                                                                                                                             Gomory-HuTree
                                                                                                                                                                         } while (p != v);}
                                                                                                                                                                                                                                                    continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      Dinic<int> G;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      struct GHT{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                             6.13
                                                                                                                                                                                                                                                                                                                                                                                                                                                        if (sem[v] == sem[mins[v]]) dom[v] = sem[v]; else buf2[v] = mins[v];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 for (auto u : ord) if (\sim buf2[u]) dom[u] = dom[buf2[u]];
                                                                     ord.clear(); ++stamp; dfs(s); for (auto u : ord) fs[u] = u, mins[u] = buf2[u] = -1;
                                                                                                                                                                                                                                         if (dfn[v] > dfn[u]) find(v), v = sem[mins[v]];
                                                                                                                                                                      int u = ord[i], p = fa[u]; sem[u] = p;
for(auto v : revg[u]) if (vis[v] == stamp) {
                                                                                                                                                                                                                                                                                                                                               buf[sem[u]].pb(u); mins[u] = u; fs[u] = p;
per(j, 0, sz(buf[p])) {
   int v = buf[p][j]; find(v);
                                                                                                                                                                                                                                                                            if (dfn[v] < dfn[sem[u]]) sem[u] = v;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              dom[ord[0]] = ord[0];
                                                                                                                                      per(i, 1, sz(ord)) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           buf[p].clear();
                                void mark(int s) {
```

6.10 DualMST

对偶图最小生成树,等于平面图所有边边权和减去平面图最大生成树

6.11 EulerianPath

```
vi ans; bool vis[N]; int p[N];
vector<pii> g[N];
void dfs(int u) {
    for(; p[u] < sz(g[u]); ++p[u]) {
        auto v = g[u][p[u]];
        if(!vis[abs(v.se)]) {
            vis[abs(v.se)] = 1;
            dfs(v.fi);
            ans.pb(-v.se);
    }
}</pre>
```

3.12 FindCircle

```
void ini(int_n) { n = _n; G.ini(n + 5); rep(i, 1, n+1) id[i] = i, g[i].clear(); }
void link(int u, int v, int w) { G.link(u, v, w); G.link(v, u, w);}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if (dep[u] < dep[v]) swap(u, v); per(i, 0, M) if (dep[f[u][i]] >= dep[v]) res = min(res, h[u][i]), u = f[u][i];
                                                                                                                            void solve(int 1, int r) {
   if (1 == r) return;
   int s = id[1], t = id[1+1];
   for(int i = 0; i < 6.e; i += 2) 6.cap[i] += 6.cap[i+1], 6.cap[i+1] = 0;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      h[v.fi][i] = min(h[v.fi][i-1], h[f[v.fi][i-1]][i-1]);
int id[N], tmp[N], n, f[N][M], h[N][M], dep[N];
                                                                                                                                                                                                                                                                                                                                                                                         rep(i, l, r+1) {
if (G.lv[id[i]] != -1) id[cl++] = id[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       rep(i, 1, M) {
f[v.fi][i] = f[f[v.fi][i-1]][i-1],
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   void build() { solve(1, n); dfs(1, 0); } int get(int u, int v) { // 注意 long long
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         for (auto v : g[u]) if (v.fi != fa) {
  f[v.fi][0] = u; h[v.fi][0] = v.se;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             rep(i, 0, cr) id[cl + i] = tmp[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                 else tmp[cr++] = id[i]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          void dfs(int u, int fa) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           dep[u] = dep[fa] + 1;
                                                                                                                                                                                                                                                                 int w = G.run(s, t);
                                                                                                                                                                                                                                                                                                                                                           int cl = 1, cr = 0;
                                                                                                                                                                                                                                                                                               g[s].pb(mp(t, w));
                                                                                                                                                                                                                                                                                                                                    g[t].pb(mp(s, w));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           solve(1, c1 - 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int res = pw(30);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       dfs(v.fi, u);
                                  vector<pii> g[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              solve(cl, r);
```

```
* 对于一张无边权的 DAG 图, 给定 n 个起点和对应的 n 个终点,这 n 条不相交路径的方案数为矩阵
                              * e(a1, b1), e(a1, b2)...e(a1, bn)
                                                                  * e(a2, b1), e(a2, b2)...e(a2, bn)
                                                                                                                                                                  * e(an, b1), e(an, b2)...e(an, bn)
                                                                                                                                                                                                   的行列式
per(i, 0, M) if (f[u][i] != f[v][i]) res = min(res, min(h[u][i], h[v][i])), u = f[\ |\ ]
                                                               if (u != v) res = min(res, min(h[u][0], h[v][0]));
                                   u][i], v = f[v][i];
                                                                                                     return res;
                                                                                                                                                                } tr;
```

KM6.14

```
* 即 M[i][j]=e(ai,bj)
* e(a,b) 为 a 到 b 的路径方案数
                                                                                                    6.16
                                                                                                                                                                                                                                      6.17
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 0, m+1) if (used[i]) Lx[left[i]] = d, Ly[i] += d;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          T tmp = Lx[left[u]] + Ly[i] - g[left[u]][i];
if (tmp < slack[i]) slack[i] = tmp, pre[i] = u;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for(; u != m; left[u] = left[pre[u]], u = pre[u]);
                                                                                                                                                                                                                                                                                                                                                 void go(int now) {
    rep(i, 0, m+1) used[i] = 0, slack[i] = inf;
                                                                                                                                                                                                                                                                                                  rep(i, 0, n) rep(j, 0, m) g[i][j] = -inf;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if (slack[i] < d) d = slack[v = i]
                                                                                                                                                                                                       int n, m, left[N], pre[N], used[N];
                                                                                                                                                                                                                                T g[N][N], Lx[N], Ly[N], Slack[N]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    rep(i, 0, m) if(!used[i]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                             for(u = m; ~left[u]; u = v) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       rep(i, 0, n) ans += Lx[i];
rep(i, 0, m) ans += Ly[i];
                                                                                                                                                                               static const T inf = ~0U>>2;
                                                                                                                                                                                                                                                        void ini(int _n, int _m) {
                                          // init!! , id starts from 0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               else slack[i] -= d;
                                                                                                                                                             static const int N = 505;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              fill_n(left, m, -1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 0, n) go(i);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                fili_n(Lx, n, 0);
fill_n(Ly, m, 0);
                                                                                                                                                                                                                                                                            n = _n, m = _m;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                        used[u] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                     left[m] = now;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                T d = inf;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        return ans;
                                                                                                               template<class T>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   T ans = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                           int u, v;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            T run() {
                                                                                                                                     struct KM {
                                                                   // n <= m
```

ManhattanDistance

```
Manhattan distance --> Chebyshev distance
Chebyshev distance --> Manhattan distance
                   - y >> 1
  (x + y, x - y) 
 (x + y > 1, x) 
 × × × ×
```

ManhattanDistanceMST

```
rep(i, 0, sz(v)) v[i].fi.se -= v[i].fi.fi, V.pb(v[i].fi.se);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int F(int x) { return lower_bound(all(V), x) - V.begin() + 1;
                                                                                                                                                                                                                                                                                                                                                                         void init() { rep(i, 1, sz(V) + 1) mi[i] = mp(inf, inf);
void upd(int p, pii c) {
    p = sz(V) + 1 - p;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if(t.se != inf) E.pb(mp(t.fi - s, mp(t.se, u.se)));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     for( ; p <= SZ(V); p += Ib(p)) mi[p] = min(mi[p], c);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      For( ; p >= 1; p ^{-1} lb(p)) ans = min(ans, mi[p]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         void _solve(vector<pair<pre>ctor<pair</pre>ctor<pair</pre>ctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctorctor</pr
                                                                                                                                                                                                                                                                                // 最大只要把这里所有 mi 改成 ma 就行了
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 pii t = qry(F(u.fi.se));
int s = u.fi.fi * 2 + u.fi.se;
                                                                                                                                           const int N = 101010, inf = 1e9 + 7;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   V.erase(unique(all(V)), V.end());
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         upd(F(u.fi.se), mp(s, u.se));
// 曼哈顿最小距离生成树(可以求最大)
// 这份代码处理的区域是 Y 轴右转 45
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             p = sz(V) + 1 - p;
pii ans = mp(inf, inf);
                                                                                                                                                                                      vector<pair<int, pii> > E;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      For (auto u : v) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             reverse(all(v));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              pii qry(int p) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 sort(all(V));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  sort(all(v))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            return ans;
                                                                                             namespace MMST {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    V.clear();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               init();
                                                                                                                                                                                                                                                                                                                                     pii mi[N];
```

Lindstrom Gessel Viennot Lemma 6.15

for(int u = ctz(z); u < n; u + ctz(z >> (u + 1)) + 1) {

gao(cur | (1ull << u), can & g[u], ban & g[u]), can ^= 1ull << u, ban |= 1ull << u;

```
6.19 Max clique BK
                                                                                                                                                                                               typedef unsigned long long \mathsf{T};
                                                                                                           g[i][i] should be
                                                                                                                              // g[i] is i's edge
                                                                                                                                                      // index [0..N)
// 0(3 ^ (n / 3))
                                     rep(i, 0, sz(v)) swap(v[i].fi.fi, v[i].fi.se);
_solve(v);
                                                                                                        _solve(v);
rep(i, 0, sz(v)) swap(v[i].fi.fi, v[i].fi.se);
void solve(vector<pair<pii, int> > v) {
                                                                                  rep(i, 0, sz(v)) v[i].fi.fi *= -1;
                    solve(v);
                                                                                                                                                        solve(v);
```

i.18 MaxMatch

```
if(!link[v] || dfs(link[v], g)) { return link[v] = u, 1; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     fill_n(vis, n+1, 0);
per(i, 1, n+1) link[link[i]] = i;
rep(i, 1, n+1) if (!link[i]) vis[i] = use[i] = 1, Q.push(i);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 1, n+1) if (link[i] && !use[link[i]]) use[i] = 2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if (!vis[v]) vis[v] = 1, 0.push(v);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if (!vis[v]) vis[v] = 1, 0.push(v);
                                            int link[N], vis[N], use[N], in[N];
                                                                                                                                                                                                                                                                                                              int solve(int n, int m, vi g[]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int u = Q.front(); Q.pop();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               for (auto v : g[u]) { use[v] = 2;
                                                                                                                                                                                                                                                                                                                                                                               rep(i, 1, n+1) {
fill_n(vis, m+1, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             void MVC(int n, vi g[]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int v = link[u];
                                                                                        int dfs(int u, vi g[]) {
                                                                                                              for(auto v : g[u]) {
   if(!vis[v]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if (use[u] == 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           while (!Q.empty()) {
                                                                                                                                                                                                                                                                                                                                                                                                                               ret += dfs(i, g);
                                                                                                                                                                                                                                                                                                                                    fill_n(link, m+1,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           use[v] = 1;
                                                                                                                                                                    vis[v] = 1;
                      const int N = 1050;
namespace MaxMatch {
                                                                                                                                                                                                                                                                                                                                                            int ret = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return ret;
                                                                       queue<int> 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 }else {
                                                                                                                                                                                                                                                                return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   return;
```

// g[i][i] should be 0 // g[i] is i's edge // index [0..N) // 0(3 ^ (n / 3)) typedef unsigned long long T; struct BK { static const int N = 100; T g[N]; inline int ctz(T s){ return s ? __builtin_ctzll(s) : 64;} int n, ans; void ini(int _n) { //per(i, 0, n = _n) g[i] = 0; rep(i, 0, n) rep(j, 0, n) if (a[i][i]) g[i] |= 1ull << i;); } void gao(T cur, T can, T ban) { if (!can && !ban) { ans = max(ans, __builtin_popcountll(cur)); return; if (!can) return; int piv = ctz(can | ban), ret = 0; T z = can & ~g[piv];

6.20 Max_clique_fastest

int run() { gao(ans = 0, (1ull << n) - 1, 0); **return** ans; }

```
Maxclique(BB *conn, int sz, const db tt = 0.025): pk(0), lv(1), Tlimit(tt) {
                                                                                                                                                        //cc : ColorClass
                                                                                  //ves: Vertices
                                                                                                                                                                                                                                                                                                                                                                                                                          void deg_sort(ves &R) { set_deg(R); sort(all(R), desc_deg); }
                                                                                                                                                                                                                                                rep(i, 0, sz) V.pb(ve(i)); e = conn;
                                                                                                                                    typedef vector<ve> ves; ves V;
typedef vector<int> cc; cc Q, QMAX;
                                                             const BB *e; int pk, lv; db Tlimit;
                                                                                                                                                                                                                                                                   C.resize(sz + 1);
                                                                                                                                                                                                                                                                                         S.resize(sz + 1)
                      typedef bool BB[N];
const int N = 130
                                            struct Maxclique
                                                                                                                                                                             vector<cc> C;
                                                                                                                                                                                                   vector<sc> S;
```

```
for(p = t;p != s;p = to[k^1]) pl = min(pl, cap[k = pre[p]]);

for(p = t;p != s;p = to[k^1]) cap[k = pre[p]] -= pl, cap[k^1] += pl;
int c = Q.front(); Q.pop(); ing[c] = 0;
for(int k = h[c]; -k; k = ne[k]) if (cap[k] > 0) {
                                                                                                                                                                                    if(!ing[v]) Q.push(v) , ing[v] = 1;
                                                                                   if(dis[c] + cost[k] < dis[v]){
  dis[v] = dis[c] + cost[k];</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               int dfn[N], low[N], id[N], st[N],_st,_,cc;
                                                                                                                                                                                                                                                                                                                                                                                                  _t){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 U pl = inf; int p, k;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 return mp(flow, mincost);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      mincost += pl * dis[t];
                                                                                                                                                    pre[v] = k;
                                                                int v = to[k];
                                                                                                                                                                                                                                                                                                                                                                                             s, int
                                                                                                                                                                                                                                                                                                     return dis[t] != inf;
                                                                                                                                                                                                                                                                                                                                                                                                                              s = \_s, t = \_t;
flow = mincost = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             void dfs(int c,vi g[]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           dfn[c]=low[c]=++cc
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 const int N = 100050
                                                                                                                                                                                                                                                                                                                                                                                             pair<U, V> run(int
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         flow += pl;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     while(spfa()){
                                                                                                                                                                                                                                                                                                                                                                 U flow; V mincost;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       st[_st++]=c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          // _ starts from 0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        namespace SCC{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         6.22
  bool cut1(int pi , cc &va) { rep(i, 0, sz(va)) if (e[pi][va[i]]) return true; return |
                                                            void cut2(ves &va, ves &vb) { rep(i, 0, sz(va) - 1) if (e[va.back().i][va[i].i]) vb.
                                                                                                                                                                                                                                                                                                                                                                                                                         rep(k, min_k, maxno + 1) rep(i, 0, sz(C[k])) R[j].i = C[k][i], R[j++].d = k;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              void mcqdyn(int *mxc, int &sz) { // mcqdyn(int maxclique, int &siz)
                                                                                                                                                                                                                                                                                                     if (k > maxno) C[(maxno = k) + 1].clear(); C[k].pb(pi);
if (k < min_k) R[j++].i = pi;</pre>
                                                                                                                                                 int j = 0, maxno = 1, min_k = max(sz(QMAX) - sz(Q) + 1,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        set_deg(V); sort(all(V), desc_deg);
ini_col(V); rep(i, 0, sz(V) + 1) S[i].a = S[i].b = 0;
exp_dyn(V); per(i, 0, sz(QMAX)) mxc[i] = QMAX[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if (sz(Rp)) {
   if ((db) S[lv].a / ++pk < Tlimit) deg_sort(Rp);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        for (; sz(R); Q.pop_back(), R.pop_back()) {
   if (sz(Q) + R.back().d <= sz(QMAX)) return;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  else if (sz(Q) > sz(QMAX)) QMAX = Q;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                co_sort(Rp); S[lv++].a++;
                                                                                                                                                                                                                                                                       while (cut1(pi, C[k])) k++;
                                                                                                                                                                               rep(i, 1, 3) C[i].clear();
rep(i, 0, sz(R)) {
int pi = R[i].i, k = 1;
                                                                                                                                                                                                                                                                                                                                                                                           if (j > 0) R[j - 1].d = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        exp_dyn(Rp); —1v;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             S[1v].b = S[1v - 1].a;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     ves Rp; cut2(R, Rp);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       Q.pb(R.back().i);
                                                                                                                        void co_sort(ves &R) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    sz = sz(QMAX);
                                                                                       pb(va[i].i); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        6.21
```

MinCostMaxFlow

```
П
                                                                                                                                       int h[N], ing[N], pre[N], to[M], ne[M], e, s, t, n;
U cap[M]; V dis[N], cost[M];
void ini(int _n = N){ fill(h , h + (n=_n) , -1);e = 0;}
void liu(int u,int v,U c,V w){ to[e] = v;ne[e] = h[u];cap[e] = c;cost[e] = w;h[u]
                                                                                                                                                                                                                                                                                                                       void link(int u,int v,U c,V w){ liu(u,v,c,w);liu(v,u,0,-w);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                    Q.push(s), ing[s] = 1, dis[s] = 0;
                                                                                                      static const int N = 6000, M = 201010,
// [\mathtt{0},\mathtt{n}) , init!! , inf modify
                                                                                                                                                                                                                                                                                                                                                                                                                                fill(dis, dis+n, inf);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     while(!Q.empty()){
                                   template<class U, class V>
                                                                                                                                                                                                                                                                                                                                                                                                  queue<int> 0;
                                                                                                                                                                                                                                                                                                                                                              bool spfa().
                                                                          struct MCMF{
```

```
rep(i,0,n) for(auto j:g[i]) if(id[i]!=id[j]) ng[id[i]].pb(id[j]);
for(auto t:g[c])
   if(!dfn[t]) dfs(t,g),low[c]=min(low[c],low[t]);
   else if(!id[t]) low[c] =min(low[c],dfn[t]);
if(low[c]==dfn[c]){
                                                                                                                                         do{id[st[---st]]=_;}while(st[_st]!=c);
                                                                                                                                                                                                                                                                                                                                                              rep(i,0,n) if(!dfn[i]) dfs(i,g);
                                                                                                                                                                                                                                                  int solve(int n, vi g[]){
                                                                                                                                                                                                                                                                                                          fill_n(low, n, _st=0);
                                                                                                                                                                                                                                                                                                                                                                                            rep(i, 0, n) \longrightarrow id[i]
                                                                                                                                                                                                                                                                                fill_n(dfn, n, cc=0)
                                                                                                                                                                                                                                                                                                                                    fill_n(id,n,_=0);
                                                                                                                                                                                                                                                                                                                                                                                                                          fill_n(ng, _, vi())
                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return _;
                                                                                                                                                                                                                        vi ng[N];
```

```
t1), node(i, j, t2));
                                                                                                                                     for (int t = msk \& (msk - 1); t > 0; t = (t - 1) \& msk)
                                                                                                                                                                                                                                           if (z > w) z = w, pre[msk][i][j] = mp(node(i, j,
                                                                                                                                                                     int t1 = t | st[i][j], t2 = msk ^ t | st[i][j];
int w = dp[t1][i][j] + dp[t2][i][j] - a[i][j];
                                                                                                                                                                                                                                                                                                              if (z < inf) q.push(mp(i, j)), vis[msk][i][j] = 1;
                                rep(j, 1, m+1) {
    if (st[i][j] && !(st[i][j] & msk)) continue;
    int &z = dp[msk][i][j];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      rep(i, 1, n+1) rep(j, 1, m+1) if (ans > dp[S][i][j]]) ans = dp[S][i][j], now = node(i, j, S);
rep(i, 1, n+1)
                                                                                                                                                                                                                                                                                                                                                                                      spfa(msk);
                                                                                                                                                                                                                                                                                                                                                                                                                                                      ans = inf;
```

$StoerWagner_O(n3)$

```
rep(i, 1, n+1) if (!vis[i] && !use[i] && val[i] >= ma) ma = val[i], t = i;
                                                                                                                                                                                                                                 void add_edge(int u, int v, int w) { g[u][v] += w; g[v][u] += w; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 rep(i, 1, n+1) if (!vis[i] && !use[i]) val[i] += g[t][i];
                                                                                                                                                                                                                                                                                                                                                                                                                                           int MinimumCutPhase(int cnt, int &s, int &t) {
                     static const int N = 305, INF = 0x3f3f3f3f;
                                                                                                                                                                           rep(i, 1, n+1) fill_n(g[i] + 1, n, 0);
                                                                                                                             n = _n;
fill_n(use + 1, n, 0);
                                                                                                                                                                                                                                                                                                           g[v][i] += g[u][i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                     fill_n(val + 1, n, 0);
fill_n(vis + 1, n, 0);
                                                                                                                                                                                                                                                                                                                                     g[i][v] += g[i][u];
                                                                                                                                                                                                                                                           void merge(int u, int v)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if (!ma) return 0;
                                                 int n, g[N][N], val[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         vis[s = t] = 1;
                                                                         bool vis[N], use[N];
                                                                                                 void init(int _n) {
                                                                                                                                                                                                                                                                                       rep(i, 1, n+1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               while (—cnt) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int ma = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            return val[t];
struct StoerWagner{
                                                                                                                                                                                                                                                                                                                                                                                         use[u] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                int solve() {
```

```
for (int i = n, s, t; i > 1; —i) {
                                                                                                                                                                                                                                                                                                                                                                                                                                      return ans == inf ? -1 : ans;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           int res = INF;
                                                                                                                                                                                                                                                                                                                                                                                                            dfs(now);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      z = w, pre[t][nx][ny] = mp(node(x, y, msk), node(x, y, 0));
if (t == msk && ivis[msk][nx][ny]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          rep(i, 0, 4) {
int nx = x + dx[i], ny = y + dy[i], t = msk | st[nx][ny];
if (nx > n || nx < 1 || ny > m || ny < 1) continue;
if (nx > n || nx < 1 || ny > m || ny < 1)</pre>
                                                                                                                                                                                                                                                                                                                           node(int \times = 0, int y = 0, int msk = 0):x(x), y(y), msk(msk){}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int \&z = dp[t][nx][ny], w = dp[msk][x][y] + a[nx][ny];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        pre[pw(k++)][ij[j] = mp(node(0, 0, 0), node(0, 0, 0));
                                                                                                                     int n, m, k, a[N][N], st[N][N], dp[1 << M][N][N][N], S,
bool use[N][N], vis[1 << M][N][N];</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     pair<node, node> t = pre[now.msk][now.x][now.y];
                                                            // 要视图的情况使用 spfa, dijstra, 多源 bfs
const int N = 11, M = 10, inf = 0x3f3f3f3f
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  vis[msk][nx][ny] = 1;
                                                                                                                                                                                                                                                                                                                                                                                     pair<node, node> pre[1 << M][N][N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 d.push(mp(nx, ny));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                        pii u = q.front(); q.pop();
int x = u.fi, y = u.se;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            rep(i, 1, n+1) rep(j, 1, m+1)
cin >> a[i][j];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  memset(dp, 0x3f, sizeof(dp))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int SteinerTree(int n, int m)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              dp[pw(k)][i][j] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            node t1 = t.fi, t2 = t.se
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if (!a[i][j]) {
    st[i][j] = pw(k);
                                                                                                                                                                             int dx[] = {1, -1, 0, 0};
int dy[] = {0, 0, 1, -1};
queue<pii> q;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               vis[msk][x][y] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      use[now.x][now.y] = 1;
SteinerTree
                                                                                                                                                                                                                                                                                                                                                                                                                                           while (!q.empty()) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if (t2.msk) dfs(t2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            rep(msk, 1, S+1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if (!t1.x) return;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              \mathbf{if} (z > w) 
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    void dfs(node now) {
                                                                                                                                                                                                                                                                                                                                                                                                                  void spfa(int msk)
                                                                                                                                                                                                                                                                                                 int x, y, msk;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               S = pw(k) - 1;
                                                                                                                                                                                                                                                               struct node {
6.23
```

```
void ini(int _n = N){ fill(h , h + (n=_n) , -1);e = 0;}
void liu(int u,int v,U c,V w){ to[e] = v;ne[e] = h[u];cap[e] = c;cost[e] = w;h[u] =
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if(!v[t] \& cap[k] > 0) Min = min(Min , dis[t] + cost[k] - dis[c]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(c == t) return flow += mx , mincost += mx * dis[s] , mx;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if(!v[t] \& act[k] > 0 \& dis[c] - cost[k] == dis[t])
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 void link(int u,int v,U c,V w){ liu(u,v,c,w);liu(v,u,0,-w);
                                                                                                                                                                                                                                                                                                                                                                                                                   int h[N] , ing[N] , v[N] , to[M] , ne[M] , e , s , t , n;
U cap[M];V dis[N] , cost[M];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if(!ing[v]) Q.push(v), ing[v] = true;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         U tmp = dfs(t , min(cap[k] , mx - ret));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   rep(c,0,n) if(v[c]) for(int k=h[c];-k;k=ne[k]){
int t=to[k];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int c = Q.front();Q.pop();ing[c] = false;
res = min(res, MinimumCutPhase(i, s, t));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if(cap[k^1] <= 0) continue;
if(dis[c] + cost[k^1] < dis[v]){
    dis[v] = dis[c] + cost[k^1];</pre>
                                                                                                                                                                                                                                                                                                                                                                                    static const int N = 1010, M = 40404;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       rep(i,0,n) if(v[i]) dis[i] += Min;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       for(int k=h[c];~k;k=ne[k]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if(Min == inf) return false;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 for(int k=h[c];~k;k=ne[k]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    ing[t] = true, dis[t] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   v[c] = true; U ret = 0;
                                                                                                                                                                                                                                                                                                     // [0,n) , init!! , inf modify
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int v = to[k]
                           if (res == 0) break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         fill(dis,dis+n,inf);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                int t = to[k];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 while(!Q.empty()){
                                                                                                                                                                                                                                                                                                                                  template<class U, class V>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           U dfs(int c,U mx){
                                                          merge(s, t);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            queue<int> 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    U flow;V mincost;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       return true;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            bool modlable(){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              V Min = inf
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    Q.push(t);
                                                                                                                   return res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 void spfa(){
                                                                                                                                                                                                                                   ZKW
                                                                                                                                                                                                                                                                                                                                                             struct ZKW{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           6++;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     while (!q.empty() && (vis[q.top().se] || val[q.top().se] != q.top().fi)) q.pop
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int findset(int u) { return u == fa[u] ? u : fa[u] = findset(fa[u]); }
                                                                                                                                                                                                                                                                                                                                                           int head[N], val[N], e, n, to[M], ne[M], data[M], fa[N], link[N];
                                                                                                                                                                                                                                                                                                                              static const int N = 3005, M = 1000005 * 2, INF = 0x3f3f3f3f
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     to[e] = v; data[e] = w; ne[e] = head[u]; head[u] = e++; to[e] = u; data[e] = w; ne[e] = head[v]; head[v] = e++;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if (!vis[v]) q.push(mp(val[v] += data[p], v));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         for (int p = head[u]; -p; p = ne[p]) {
   int v = findset(to[p]);
res = min(res, MinimumCutPhase(i, s, t));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   int MinimumCutPhase(int cnt, int &s, int &t) {
                                                                                                                                                                                                                                   {
m StoerWagner\_O(nmlog(m))}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            for (int u = s; ~u; u = link[u]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           for (int i = n, s, t; i > 1; —i) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            void add_edge(int u, int v, int w) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  while (-link[p]) p = link[p];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if (q.empty()) return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           t = q.top().se; q.pop();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    rep(i, 1, n+1) fa[i] = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         fill_n(link + 1, n, -1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                     n = _n;
fill_n(head + 1, n, -1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            void merge(int u, int v) {
                           if (res == 0) break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 fill_n(val + 1, n, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            fill_n(vis + 1, n, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           priority_queue<pii> q;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      while (—cnt) {
   vis[s = t] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                   void init(int _n) {
                                                        merge(s, t);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int solve() {
  int res = INF;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return val[t];
                                                                                                                                                                                                                                                                                                     struct StoerWagner{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                link[p] = v;
                                                                                                                     return res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               fa[v] = u;
                                                                                                                                                                                                                                                                                                                                                                                        bool vis[N]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      6.25
                                                                                                                                                                           } SW;
```

```
val[p] = val[ori], id[p] = id[ori], ht[p] = ht[ori];
                                                                                                                                                                                                                 inline int newnode(db _val, int _id, int _dis = 0){
                                                                                                                                                                   int ls[M*B], rs[M*B], ht[M*B], id[M*B], tot;
                                                                                                                                                                                                                                                               val[p] = _val, id[p]=_id, ht[p] = _dis;
                                                                                                                                                                                                                                                                                                                                                                                                                                   ls[p] = ls[ori], rs[p] = rs[ori];
fa[v] = u; tree[i] = 1;
                                                                                                                                                                                                                                                                                                                                                             inline int _copy(int ori){
                                                                                                                                                                                                                                                                                       ls[p] = rs[p] = 0;
                                                                                                                                                                                                                                                                                                                                                                                       int p = ++tot;
                                                                                                                                                                                                                                           int p = ++tot;
                         dfs(v);
                                                                                                                                                                                         db val[M*B];
                                                                                                                                                                                                                                                                                                                   return p;
                                                                                                                                               namespace LT{
                                                                                                                     int rt[N];
 cap[k] —= tmp , cap[k^1] += tmp;
                                               if(ret == mx) return ret;
                                                                                                                                                                                                                                         flow = mincost = 0;
do do memset(v,0,sizeof(v[0])*n);
                                                                                                                                                                                                                                                                                                                                       return make_pair(flow , mincost)
                                                                                                                                                                   pair<U,V> run(int _s,int _t){
                                                                                                                                                                                                                                                                                           while(dfs(s,inf));
                         ret += tmp;
                                                                                                                                                                                                                                                                                                                 while(modlable());
                                                                                                                                                                                           s = _{-}s , t = _{-}t;
                                                                                                                       return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                 k短路
                                                                                                                                                                                                                     spfa();
```

6.27

```
if (!tree[i] && dis[v] < inf) LT::ins(rt[u], dis[v] - dis[u] + g.w[i], v);
                                                                                                                                                                                                                                                                                                                                        inline void ins(int &rt, db val, int id){ rt = merge(rt, newnode(val, id)); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if (rt[o]) pq.push(mp(w + LT::val[rt[o]], rt[o]));
if (ls) pq.push(mp(w + LT::val[ls] - LT::val[u], ls));
                                                                                                                                                                                                           if(ht[ls[now]] < ht[rs[now]]) swap(ls[now],rs[now]);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if (rt[S]) pq.push(mp(dis[S] + LT::val[rt[S]], rt[S]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              priority_queue<pdi, vector<pdi>, greater<pdi> > pq;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     E -= w; if (E >= 0) ++ans; else return ans;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   db w = t.fi; int u = t.se, o = LT::id[u];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for (int i = g.h[u]; i ; i = g.ne[i]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               int ls = LT::ls[u], rs = LT::rs[u];
                                                                                                                     if(val[a] > val[b]) swap(a, b);
                                                       inline int merge(int a, int b){
                                                                                                                                               int now = _copy(a);
rs[now] = merge(rs[now], b);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    pdi t = pq.top(); pq.pop();
                                                                                                                                                                                                                                             ht[now] = ht[rs[now]] + 1;
                                                                                      if(!a || !b) return a|b;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int ans = 1; E = dis[S];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    typedef pair<db, int> pdi;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            rt[u] = rt[fa[u]];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int v = g.to[i]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       while(!pq.empty()) {
                                                                                                                                                                                                                                                                                                                                                                                                                                   rep(j, 1, top+1) {
    int u = st[j];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           inline int calc_K(){
                                                                                                                                                                                                                                                                                                                                                                                                 void build_heap(){
                                                                                                                                                                                                                                                                              return now;
return p;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     ф
Е;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if (!vis[v] && fabs(dis[v] - dis[u] - rg.w[i]) <= eps) {</pre>
                                                                                                                                                                                                                                                                                                                                                                           ne[++e] = h[u], h[u] = e, to[e] = v, w[e] = val;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    int v = rg.to[i];
if (dis[v] > dis[u] + rg.w[i] + eps) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            for (int i = rg.h[u]; i; i = rg.ne[i]) {
                                                           // time : O(klogk + mlogn) space : O(nlogn)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    for (int i = rg.h[u]; i; i = rg.ne[i]) {
                                                                                                                                                                                                                                                                                                                                            inline void add(int u, int v, db val){
                                                                                                                                                                                     bool vis[N], tree[M];
int n, m, S, T, fa[N], st[N], top, u, v;
struct Graph{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if (vis[u]) continue; vis[u] = 1;
                                                                                          const int N = 5050, M = 200005, B = 20,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       dis[v] = dis[u] + rg.w[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  priority_queue<pair<db, int> > pq;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int u = pq.top().se; pq.pop();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   pq.push(mp(-dis[v], v));
                                                                                                                          const db eps = 1e-9, inf = 1e16;
                          // S -> T 可重复经过点的第 K 短路
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 rep(i, 1, n+1) dis[i] = inf;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    pq.push(mp(dis[T] = 0, T));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       st[++top] = u; vis[u] = 1;
                                                                                                                                                                                                                                                                                int h[N], ne[M], to[M], e;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              while(!pq.empty()){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int v = rg.to[i]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          void dfs(int u){
                                                                                                                                                           db dis[N], w;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                    void Dij(){
                                                                                                                                                                                                                                                                                                                    db w[M];
                                                                                                                                                                                                                                                                                                                                                                                                                                               } g, rg;
```

```
rep(i, 0, n) rep(j, 0, n) d[i][j] = g[i][j], rk[i][j] = j;
rep(k, 0, n) rep(i, 0, n) rep(j, 0, n)
d[i][j] = min(d[i][j], d[i][k] + d[k][j]);
rep(i, 0, n) sort(rk[i], rk[i] + n, [&](int a, int b) {return d[i][a] < d[i][b];});</pre>
                                                                                                                                                                                                                                                                                                                                                                                                      if (d[v][x] > d[v][y]) {
  int tmp = d[u][x] + d[v][y] + g[u][v];
                                                                                                                                                                                                                                                                                                                                                  for (int k = n - 1, i = n - 2; i >= 0; —i) int x = rk[u][i], y = rk[u][k];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     ret = tmp, s1 = u, s2 = v;

ds1 = 0.5 * tmp - d[u][x];
                                                                                                                                                                                   if (d[u][rk[u][n - 1]] * 2 < ret) {
    ret = d[u][rk[u][n - 1]] * 2;</pre>
                                                                                                                                                                                                                                                                                                                        rep(v, 0, n) if (g[u][v] != inf) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ds2 = g[u][v] - ds1;
                                                                                                           int ret = inf, s_1 = -1, s_2 = -1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                              if (tmp < ret) {</pre>
                                                                                                                                    db ds1 = 0, ds2 = 0;
                                                                                                                                                                                                                                                                        ds1 = ds2 = 0;
                                                                                                                                                                                                                                             s1 = s2 = u;
                                                                                                                                                               rep(u, 0, n) {
  if (rs) pq.push(mp(w + LT::val[rs] - LT::val[u], rs));
                                                                                                                                                                                                                                                                                                                                                                                                    rep(i, 1, n+1) vis[i] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       cout << calc_K() << endl;
                                                                                                                                    ios::sync_with_stdio(0)
cin.tie(0);
                                                                                                                                                                                                                                       rep(i, 1, m+1) {
cin >> u >> v >> w;
                                                                                                                                                                                                                                                                                                                                rg.add(v, u, w);
                                                                                                                                                                                          cin >> n >> m >> E;
                                                                                                                                                                                                                                                                                                   g.add(u, v, w);
                                                                                                                                                                                                                S = 1; T = n;
                                                                                                                                                                                                                                                                                                                                                                                                                                                            build_heap();
                                                         return ans;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    return 0;
                                                                                                           int main(){
                                                                                                                                                                                                                                                                                                                                                                                                                                     dfs(T);
                                                                                                                                                                                                                                                                                                                                                                           Dij();
```

31 完美消除序列

cout << ret / 2.0 << endl;

* 建出圆方树,选任意圆点作为根,环的根指的是环上深度最小的点。 * 圆圆边边权不变,圆方边边权是圆点到它所在环的根的最短距离。 * 如果询问两点的 1ca 是圆点, ans = dep[a] + dep[b] - dep[lca] * 如果是方点, ans = dep[a] + dep[b] - dep[A] - dep[B] + dis(A, B)

仙人掌最短路

6.28

return mp(s1, s2);

k = i

```
vi g[N];
                                                                                                                                       int L, hd[::N], ne[N], to[N]; 11 val[N];
inline void init(int n) { L = 0; rep(i, 1, n + 1) hd[i] = -1; }
inline void _add(int u, int v, 11 w) { to[L] = v; val[L] = w; ne[L] = hd[u]; hd[u]
                                                                                                                                                                                                                                                                inline void add(int u, int v, 11 w) { _add(u, v, w); _add(v, u, w); }
                                                                                                          static const int N = ::N << 1;
前向星
                                                                                struct Gra {
                                                                                                                                                                                                                                        [++;
    6.29
```

6.30 图绝对中心

```
cood Executive:
// id : 0 .. n - 1
// time : O(n ^ 3)
// g[i][i] should be 0
const int N = 1e3 + 7, inf = 1e9 + 7;
int n, m, g[N][N], u, v, w;
pii GraphCenter(int n, int g[][N]) {
    static int rk[N][N], d[N][N];
}
```

const int N = 1e5 + 7, M = 2e6 + 7; | int ans, use[N], col[N], lab[N], vis[N], a[N], e, m, ne[M], h[N], to[M], u, v, n, vi g[N];

ma;

```
vi g[N];
void ins(int p, int v) { ++e; to[e] = v; ne[e] = h[p]; h[p] = e; }

void del(int p) {
    h[p] = ne[h[p]];
    while (!h[ma]) ma—;
}

int solve(){
    cin >> n >> m;
    rep(i, 0, m) {
        cin >> v;
        g[u].pb(v); g[v].pb(u);
    }

e = ma = 0; // 完美消除序列
    rep(i, 1, n+1) ins(0, i);
    per(i, 1, n+1) {
        while (1) {
            u = to[h[ma]]; del(ma);
        if (!vis[u]) break;
```

```
if(v == s \mid | (match[v] >= 0 \& pred[match[v]] >= 0))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        rep(i, 0, n) if (match[i] == -1) if (Find(i)) AugmentPath(); rep(i, 0, n) if (match[i] != -1) res++; return res / 2;
                                                                                                                                                                                                                                                      rep(i, 0, n) pred[i] = -1, b[i] = i, inq[i] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if (match[v] >= 0) push(match[v]);
else return t = v, 1;
                                                                                                                                                                                                                                                                                                                                                                                                                        if (b[u] != b[v] \&\& match[u] != v)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             else if(pred[v] == -1) {
                                           if(b[u] != newb) pred[u] = v;
if(b[v] != newb) pred[v] = u;
rep(i, 0, n) if (inb[b[i]]) {
   b[i] = newb;
if (!inq[i]) push(i);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    // random_shuffle maybe faster
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    match[v] = u, match[u] = v;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                v = pred[u], w = match[v];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           rep(i, 0, n) match[i] = -1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                       Blossom(u, v);
                                                                                                                                                                                                                                                                               S = U, t = -1, L = R = 0;
                                                                                                                                                                                                                                                                                                                                                                         per(i, 0, sz(g[u])) {
                                                                                                                                                                                                                                                                                                                                                                                                 int v = g[u][i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      pred[v]=u;
                                                                                                                                                                                                                                                                                                                                                      int u = pop();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          void AugmentPath() {
                                                                                                                                                                                                           bool Find(int u) {
  bool found = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int u = t, v, w; while (u >= 0) {
                                                                                                                                                                                                                                                                                                                           while(L < R) {
                         ResetTrace(v);
ResetTrace(u);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               return found;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int res = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                int solve() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               .,
□
□
                                                                                                                                                                                                                                                                                                   ;(s)ysnd
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                }
}
6;
```

} ans = 0; per(i, 1, n+1) { // 色数 for (auto v : g[a[i]]) use[col[v]] = i; rep(j, 1, n+1) if (use[j] != i) { col[a[i]] = j;

for (auto v : g[u]) {
 ins(++lab[v], v);
 ma = max(lab[v], ma);

a[i] = u, vis[u] = 1;

ans = max(ans, col[a[i]]);

break;

return ans;

最短路矩阵中第 k 小

```
int n, m, k, u, v, w;
struct data { // 距离起点当前点当前扩展过的边编号
11 w; int st, last, id;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    vector<pii>yelN]; // ( 边权 , 终点 ) 需要排序
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      const int N = 2e5 + 7;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    6.33
                                                                                                                                                          int u, v, n, match[N], q[N], L, R, pred[N], b[N], s, t, newb;
bool inq[N], inb[N];
void init(int _n) { n = _n; rep(i, 0, n) g[i].clear(); }
void link(int u, int v) { g[u].pb(v); g[v].pb(u); }
void push(int u) { q[R++] = u; inq[u] = 1; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if(b[u] i= newb) pred[u] = v;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 inb[b[u]] = inb[b[v]] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if (inp[v = b[v]]) break;
                                                                                                                                                                                                                                                                            int pop() { return q[L++]; }
int LCA(int u, int v) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             void Blossom(int u,int v) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          rep(i, 0, n) inb[i] = 0;
                                                                                                                   static const int N = 5005;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       v = pred[match[v]];
                                                                                                                                                                                                                                                                                                                       rep(i, 0, n) inp[i]=0;
                                                                                                                                                                                                                                                                                                                                                                                                           u = pred[match[u]];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         void ResetTrace(int u) {
                                                                                                                                                                                                                                                                                                                                                                inp[u = b[u]] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      while(b[u] != newb) {
                                                                                                                                                                                                                                                                                                                                                                                          if (u == s) break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            v = match[u];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      newb = LCA(u, v);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       u = pred[v];
带花树
                                                                                                                                                                                                                                                                                                                                             while(1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                            while(1) {
                                                     // time : O(n^{3})
// id : O .. n-1
                                                                                           struct blossom {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   return v;
                                                                                                                                           vi g[N];
 6.32
```

```
// ec(G) = tw(G) * pi((deg[v] - 1)!)
// ans = ec(G) * deg[w]; 如果求的不是本质不同的,就还需要这个
                                                                                                                                                                                                                                                                                                                 rep(i, 1, n+1) q.push(i), pos[i] = 0, mat[i] = 0; while (!q.empty()) {
                                                                                                                                                                                                                                                                                                                                                                                                                                               else if (rank[v][mat[v]] > rank[v][u]) {
                                                                                                                                                                                                                                                                                       void match(int n, vi *g, vi *rank) {
                                                                                                                                                                                                                                                                                                                                                                 int u = q.front(); q.pop();
int &p = pos[u], v = g[u][p];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    = i;
                                              1231341 1341231
                                                                         1231341 1312341
                                                                                                                                                                                                                                                                                                                                                                                                                      if (!mat[v]) mat[v] = u;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    rep(i, 1, n+1) mat1[mat[i]]
                                                                                                                                                                                        int mat1[N], mat[N], pos[N];
vi g1[N], g2[N];
                                                                                                                            稳定婚姻匹配
                                                                                                                                                                                                                                                                                                                                                                                                                                                                          q.push(mat[v]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       else q.push(u);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   mat[v] = u;
                                                                                                                                                                                                                                              queue<int> q;
                                                  // 本质相同:
                                                                       // 本质不同:
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    ;
++d
                                                                                                                              6.35
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                pq.push(data(u.w - g[u.last][u.id].fi + g[u.last][u.id + 1].fi, u.st, u.last, u
. ;I =
                                                                     连通图的话 k <= n^* (n-1) 复杂度最坏应该是 O(klogk + nlogn)
                                                                                                                                                                                                                                                                                                                                                                                                                                                        if (sz(g[v])) pq.push(data(u.w + g[v][0].fi, u.st, v, 0));
data(11 W, int S, int L, int I) { w = W; st = S; last = L; id
                         bool operator < (const data &c) const { return w > c.w; }
                                                                                                                                                                                                rep(i, 1, n+1) {
    if (sz(g[i])) pq.push(data(g[i][0].fi, i, i, 0));
                                                                                                                          solve(int n, vector<pii> g[], int k)
                                                                                                                                                                                                                                                                                                                                                                                                      vis.insert(mp(u.st, v));
k—; if (k == 0) return u.w;
                                                                                                                                                                                                                                                                                                                                                                               if (!vis.count(mp(u.st, v))) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    }
if (u.id + 1 < sz(g[u.last]))
                                                                                                                                                                                                                                                                                                                              data \ u = pq.top(); pq.pop();
                                                                                                                                                                                                                                                                                                                                                       int v = g[u.last][u.id].se;
                                                                                                                                                                                                                                                    vis.insert(mp(i, i));
                                                                                                                                                       priority_queue<data> pq;
                                                                                                                                                                                                                                                                                                     while (!pq.empty()) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              ;((1 + pi);
                                                                                                                                                                              set<pii>set<pii>set<
                                                  ///
```

6.34 生成树计数与欧拉回路方案数

```
rep(k, i, n) a[i][k] = sub(a[i][k], mul(a[j][k], t)), swap(a[i][k], a[j][k]);
                                                                                                                                                            // 无向图生成树个数: a[J[J] 任何一个 n-1 阶主子式的绝对值
// 有向图以 i 为根的生成树个数: a[J[J] 去掉第 i 行第 i 列的行列式的绝对值
                                                                                        // from i to j has b[i][j] directed edges
// a[][] = d[][] - b[][]
                                                                                                                                                                                                                                   int det(int n) { // det(a[1..n-1][1..n-1])
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  有向图要记得判断每个点的出度入度是否相等
                                                                                                                                                                                                                                                                                                        rep(j, i+1, n) while(a[j][i]) {
                                                                                                                                                                                                                                                                                                                          int t = a[i][i] / a[j][i];
                                                                                                                                                                                                                                                                                                                                                                                                                          if(a[i][i] == 0) return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                     ans = mul(ans, a[i][i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        // 无向图需要转换成有向图
// tw(G):以 w 为根的生成树个数
                   i!=j \ d[i][j]=0

i==j \ d[i][j]=in\_deg(i)
                                                                                                                                                                                                                                                                                                                                                                              ans = P - ans;
                                                                                                                                                                                                                                                                                  rep(i, 1, n) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   return ans;
                                                                                                                                                                                                                                                              int ans=1;
                                                                 // p[][]:
// d[][]:
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    \:
```

7 Math

7.1 BerlekampMassey

```
rep(i, 0, sz(B)) C[i + m] = add(C[i + m], mul(c, B[i]));
if(2 * L <= n) L = n + 1 - L, B = T, b = d, m = 1;
                          // s_{m} = \sum_{j=0}^{m-1}s_{j}^{j} *c_{j} 系数直接适配线性递推
                                                                                                                                                                                   rep(i, 0, L+1) (d += 111 * C[i] * s[n-i]) %= P;
                                                                                                                                                                                                                                                                                     11 c = P - d * kpow(b, P - 2) % P;
                                                                                                                                                                                                                                                                                                                 while(sz(C) < sz(B) + m) C.pb(0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(i, 0, sz(C)) C[i] = P - C[i];
return vi(C.begin(), C.end() - 1);
                                                                                                    int L = 0, m = 1, b = 1; rep(n, 0, sz(s)) {
                                                                            vi C(1, 1), B(1, 1);
                                                                                                                                                                                                               if(d == 0) ++m;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                        reverse(all(C));
                                                                                                                                                                                                                                                             viT = C;
                                                                                                                                                                                                                                                                                                                                                                                              else ++m;
                                                                                                                                                      11 d = 0;
                                                  vi BM(vi s) {
                                                                                                                                                                                                                                     else {
// O(len^2)
```

```
// a[1] ^ a[1+1] ^ a[1+2] ... ^ a[r] % mod 注意结果要再模 mod
                                                                                                                                                                                                                                                                for(int i = 2; i * i <= n; i++) if (n % i == 0){ r = r / i * (i-1);
                                                                                                                                                                                                                                                                                                                                                                  if (n > 1) r = r / n * (n-1);
                                                                                                                                                                                                                 if (M.count(n)) return M[n];
                                                                                                                                                                                                                                                                                                                 while (n % i == 0) n /=
                                                                                 EulerPower
                                                                                                                                                                                                                                         int r = n, nn = n;
                                                                                                                                                                  map<int, int> M;
int phi(int n) {
                                                                                                                                                                                                                                                                                                                                                                                         M[nn] = r;
                                                                                                                                                                                                                                                                                                                                                                                                                   return r;
                                                                                 7.4
                              } crt;
                                                                                                                                                                                                                                rep(i, 0, N) C[i][0] = 1;
rep(i, 0, N) rep(j, 1, i + 1) C[i][j] = add(C[i - 1][j - 1], C[i - 1][j]);
                                                                                                                                                                                                                                                                                                                                                       rep(j, 0, i) B[i] = add(B[i], MOD - mul(C[i + 1][j], B[j]));
                                                                                                                                                                                                                                                                                                                                                                               B[i] = mul(B[i], qpow(C[i+1][i], MOD - 2)) % MOD;
                                                              // desc : 0^{\Lambda}k + 1^{\Lambda}k + 2^{\Lambda}k + ... + (n-1)^{\Lambda}k
                                                                                                                                                            const int N = 1000;
                                                                                                                                                                                   int C[N][N], B[N];
                                                                                                             // time_cal : k + log
                                                                                                                                                                                                                                                                                                         rep(i, 1, N) {
                                                                                                                                  namespace Bernoulli
                                                                                    // time_ini : O(n^2)
Bernoulli
                                                                                                                                                                                                                                                                                                                                B[i] = 0;
                                                                                                                                                                                                                                                                                 B[0] = 1;
                                                                                                                                                                                                           void ini() {
7.2
```

CRT 7.3

return mul(sum, qpow(k + 1, MOD - 2));

int cal(int n, int k)

int sum = 0;

```
R = (R % M + M) % M; // 可能为 Ø 看是否需要是正整数
                                                                                                                                                                                                                                                                                                                                                                                                                                  | 11 g = __gcd(M, mod[i]);
| 11 inv = Inv(M / g, mod[i] / g);
| if ((a[i] - R) % g) return -1; // 无解
| R += inv * ((a[i] - R) / g) % (mod[i] / g) * M;
                                                                                        11 M, R;
void exgcd(11 a, 11 b, 11 &x, 11 &y){
                                                                                                                                    if (!b) \{ x = 1; y = 0; return; \}
                                                                                                                                                                                                                                                                                                                                           }
ll solve(int n, ll *a, ll *mod){
                                                                                                                                                                                                                                                                                                                      return x < 0? x + mod : x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            M = M / g * mod[i];
                                                                                                                                                         exgcd(b, a % b, y, x);
                                                                                                                                                                                                                                                                                                                                                                                       M = mod[1], R = a[1];
                                                                                                                                                                                                                                                                          exgcd(a, mod, x, y);
                                                                                                                                                                                                                          11 Inv(11 a, 11 mod){
                                                                                                                                                                                                                                               11 \times = 0, y = 0;
                                                                                                                                                                                                                                                                                                                                                                                                              rep(i, 2, n+1) {
                                                                                                                                                                                y = a / b * x;
const int N = 1e5+7;
                     11 a[N], mod[N];
                                                                                                                                                                                                                                                                                                   :pow =% ×
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    return R;
                                                                   struct CRT{
```

```
return Euler_qpow(a[1], work(1+1, r, phi(mod)), mod);
                Euler_qpow(11 a, 11 b, 11 mod) {
11 res = 1; bool ok = (b > 0 && a >= mod);
while (b) {
                                                                                                                                                                                                                 ok |= (b > 1 \& a >= mod);
                                                                                                                                                                                                                                                                                                                                                 work(int 1, int r, int mod)
                                                                                                        res = res * a;
ok |= (res >= mod);
                                                                                                                                                                                                                                                                                                                                                                                           if (1 == r) return a[1];
                                                                                                                                                                                                                                                                                                                                                                       if (mod == 1) return 1;
                                                                                                                                                                                                                                                                                                        return res + mod * ok;
                                                                                                                                                     res %= mod;
                                                                                if (b & 1) {
                                                                                                                                                                                             a = a * a;
                                                                                                                                                                                                                                          a %= mod;
                                                                                                                                                                                                                                                                b >>= 1;
                                                                                                                                                                                                                                                                                                                             ~ I
~I
                                                       rep(i, 0, k + 1) sum = add(sum, mul(C[k + 1][i], mul(B[i], qpow(n, k + 1 - i))));
```

FFT7.5

```
vir operator -(const \ vir \&c) \{return \ vir(r-c.r, i-c.i);\}
vir operator *(const \ vir \&c) \{return \ vir(r * c.r-i * c.i, r * c.i + i * c.r);\}
                                                                                                                                                                                                                                                                                vir operator +(const vir &c) {return vir(r + c.r, i + c.i);}
                                                                                                                                                                                               vir(db \ r = 0.0, \ db \ i = 0.0) \ : \ r(r), \ i(i) \}
                                                                                                                                                                                                                                       void print() {printf("%f %f\n", r, i);}
const int M = 1 \ll 17 \ll 1;
                                     const db pi = acos(-1);
                                                                                                                                                                                                                                                                                                                                                                                                     } a[M], b[M], w[2][M];
                                                                                                                     struct vir{
                                                                                                                                                                db r, i;
```

|struct FFT{

```
vir operator *(const vir &0) const{return vir(a*0.a-b*0.b,b*0.a+a*0.b);}
                                                                                                                                                                                                                                                                                                                                                                                                                                                       rep(i, 0, N) w[i] = vir(cos(2 * i * PI / N), sin(2 * i * PI / N)); rep(i, 0, N) {
                                                                                                                                                                                                                                                                                                                                for (N = 1; N < na + nb - 1; N <<= 1); rep(i, 0, na) a[i] = (a[i] % P + P) % P; rep(i, na, N) a[i] = 0; rep(i, 0, nb) b[i] = (b[i] % P + P) % P; rep(i, nb, N) b[i] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              vir operator +(const vir &0) const{return vir(a+o.a,b+o.b);} vir operator -(const vir &0) const{return vir(a-o.a,b-o.b);}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 a[i] = ((dd << (L^*2)) + ((db + dc) << L) + da) % P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         vir operator *(const double &0) const{return vir(a*0,b*0);}
                                                             vir &p1 = p[i + j + m], &p2 = p[i + j];
vir t = w[rm * j] * p1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            db = [A[i] + !A[i]) * vir(0.5, 0),
dc = (B[i] - !B[i]) * vir(0, -0.5),
dd = (B[i] + !B[i]) * vir(0.5, 0);
C[i] = da * dd + da * dc * vir(0, 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                vir da = (A[i] - !A[j]) * vir(0, -0.5),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 db = (11)(C[i] \cdot r / N + 0.5) \% P,
dc = (11)(D[i] \cdot i / N + 0.5) \% P,
dd = (11)(D[i] \cdot r / N + 0.5) \% P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              D[\bar{j}] = db * dd + db * dc * vir(0, 1);
                                                                                                                                                                                                                                                                                                 void doit(int *a, int *b, int na, int nb){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                da = (11)(C[i].i / N + 0.5) \% P,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          vir operator !() const{return vir(a,-b);}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            A[i] = vir(a[i] >> L, a[i] & MASK);
B[i] = vir(b[i] >> L, b[i] & MASK);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             vir(double r=0.0, double i=0.0) {a=r, b=i,}
For (int i = 0; i < n; i += m2) {
                                 for (int j = 0; j < m; ++j) {
                                                                                                                               p1 = p2 - t, p2 = p2 + t;
                                                                                                                                                                                                                                                                                                                                                                                                                                L = 15; MASK = (1 << L) - 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int j = (N - 1) \% N;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                FFT(C, N), FFT(D, N);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               void mul(int *a) {
    FFT(A, N), FFT(B, N);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          const double pi=acos(-1.0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              const int N = 1 << 21
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 rep(i, 0, N) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    rep(i, 0, N) {
11 da = (11
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            double a, b;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               mul(a);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    FFT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                struct vir{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       inline vir operator *(const vir &c) {return vir(r * c.r - i * c.i, r * c.i + i * c.r)
                                                                                                                                                                                         for (int k = 0, 1 = 0; k < i; k++, 1 += t)
x = w[f][1] * a[j+k+i], y = a[j+k], a[j+k] = y+x, a[j+k+i] = y-x;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        inline vir operator +(const vir &c) {return vir(r + c.r, i + c.i);} inline vir operator -(const vir &c) {return vir(r - c.r, i - c.i);}
                                                                                                                                                                                                                                                                                                                                                                                                                           rev[i] = (rev[i>>1] >> 1) | ((i&1) << (d-1));
w[1][i] = w[0][i] = vir(cos(2*pi*i/N), sin(2*pi*i/N));
                                                                  vir x, y;
rep(i, 0, N) if (i < rev[i]) swap(a[i], a[rev[i]]);</pre>
                                                                                                                            for (int i = 1; i < N; i <<= 1)
for (int j = 0, t = N/(i<<1); j < N; j += i<<1)</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            for (int d = 0; (1 << d) < n; ++d) {
  int m = 1 << d, m2 = m * 2, rm = n >> (d + 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       inline vir operator !() const {return vir(r, -i);}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              void doit(vir *a, vir *b, int na, int nb){ // [0, for (N = 1; N < na + nb - 1; N <<= 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      for (int s = n; j = s >= 1, -j & s;);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          for (int i = 1, j = 0; i < n - 1; ++i) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         vir(db \ r = 0.0, \ db \ i = 0.0) : \ r(r), \ i(i)\{\}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          void print() {printf("%lf %lf\n", r, i);}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        work(), fft(a, 0), fft(b, 0);
rep(i, 0, N) a[i] = a[i] * b[i];
fft(a, 1);
                                                                                                                                                                                                                                                           if (f) rep(i, 0, N) a[i].r /= N;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(i, na, N) a[i] = vir(0, 0);
rep(i, nb, N) b[i] = vir(0, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if (i < j) swap(p[i], p[j]);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   static const int M = 1 \ll 18 \ll 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int N, L, MASK;
vir w[M], A[M], B[M], C[M], D[M];
void FFT(vir p[], int n) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              //rep(i, 0, N) a[i].print();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           w[1][i].i = -w[1][i].i;
                                                                                                                                                                                                                                                                                                                                                            int d = __builtin_ctz(N);
                                 void fft(vir *a, int f){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        const int M = 1 << 18 << 1;
int N, na, nb, rev[M];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            const db PI = acos(-1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int na, nb, a[M], b[M];
                                                                                                                                                                                                                                                                                                                                                                                                  rep(i, 0, N) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               FFTMOD
                                                                                                                                                                                                                                                                                                                           void work(){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             struct FFTMOD{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               struct vir{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             db r, i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  } fft;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    7.6
```

_xor 版本 k 併置 FWT7.9

```
return *this;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  Num ret = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 rep(i, 0,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          rep(i, 0,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          return c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   return c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           return c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         template <int
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        struct Num {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                Num c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        Num c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 Num c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         Num c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 11 a[K];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          for (int k = 0; 1 < k < len; ++k) rep(i, 0, len) if (-i >> k \& 1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           rep(i, 0, na+nb+1) a[i] = i&1 ? z[i>>1].b + 0.1 : z[i>>1].a + 0.1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 vir tmp = (i8K>>1) ? vir(1, 0) - w[i^{A}>>1] : w[i] + vir(1, 0) z[i] = (x[i]^{*}y[i]^{*}4 - (x[i] - !x[i])^{*}(y[i] - !y[j])^{*}(y[i] - y[j])^{*}(y[i] - y[i])^{*}(y[i] 
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    for(int i=0; i<=na; i++) (i&1 ? x[i>>1].b : x[i>>1].a) = a[i];
for(int i=0; i<=nb; i++) (i&1 ? y[i>>1].b : y[i>>1].a) = b[i];
fft(x, K, 0); fft(y, K, 0);
rep(i, 0, K){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if (v) for(int i=0; i<k; i++) x[i] = vir(x[i].a/k, x[i].b/k);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             const int P = 1e9 + 7, inv2 = P + 1 >> 1; // P is odd prime void FWT(int *a, int len, int o = 1) { // o=-1 UFWT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             vir g = vir(cos(2*pi/i), (v ? -1 : 1) * sin(2*pi/i));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 for(int j=(i>>1); j>=0; j-=2) w[j] = w[j>>1];
for(int j=1; j<i>i>+2) w[j] = w[j-1] * g;
for(int j=0; j<k; j+=i){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        void doit(int *a, int *b, int na, int nb)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          rep(i, 0, K) \times [i] = y[i] = vir(0, 0);
                                                                                                                                                                                                                                                                                                                                        for(int l=k>>1; (j^=1)<1; l>=1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      for(K = 1; K <= na+nb>>1; K <<= 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  vir *a = x+j, *b = a+(i>>1);

for(int l=0; l<i>>1; l++){
} x[N|1], y[N|1], z[N|1], w[N|1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         vir o = b[1] * w[1];
                                                                                                                                  void fft(vir x[], int k, int v){
                                                                                                                                                                                           for(int i=0, j=0; i<k; i++){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                          w[0] = vir(1, 0);
for(int i=2; i<=k; i<<=1){
                                                                                                                                                                                                                                                                    if(i>j)swap(x[i],x[j])
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        b[1] = a[\bar{1}] - 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      a[1] = a[1] + 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   int j = K-1 \& K-i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       fft(z, K, 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           \mathbf{F}\mathbf{W}\mathbf{T}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           %:
```

```
x = (a[i] + a[j]) \% P, y = (a[i] - a[j] + P) \% P, // xor

if (0 == -1) \times = (11) \times * inv2 \% P, y = (11)y * inv2 \% P,
                                                                                                                //x = (a[i] + a[j]) % P, y = a[j]; // and //if (o == -1) x = (a[i] - a[j] + P) % P; //x = a[i], y = (a[i] + a[j]) % P; // or
                                                                                                                                                                                                                                          //if (0 == -1) y = (a[j] - a[i] + P) \% P;
a[i] = x, a[j] = y;
int j = i \land (1 << k), x, y;
```

```
if (K \& 1 \land 1) ret -= add(a[K >> 1], -(L > 1)^*a[(K >> 1) + cnt]), ret %= _p;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   K) (c.a[(i + j) % K] += mul(a.a[i], b.a[j])) % = _p;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    inline Num& operator = (int \times) { mem(a, 0), a[0] = \times; return *this; } inline friend Num operator + (const Num &a, const Num &b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int cnt = KR-K, L = K / cnt; 11 ret = add(a[0], -(L > 1)*a[cnt]);
                                                                                                                                                           11 ret = 1;
for (; k; k >>= 1, x = mul(x, x)) if (k & 1) ret = mul(ret, x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        inline friend Num operator - (const Num &a, const Num &b) \{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     inline friend Num operator * (const Num &a, const Num &b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      for (; k; k'>>= 1, x = x^*x) if (k & 1) ret = ret*x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    int k)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   rep(i, 0, K) printf("a[‰] => ‰\n", i, a[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      = add(a.a[i], -b.a[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 0, K) c.a[i] = add(a.a[i], b.a[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    inline friend Num operator >> (const Num &a,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 inline friend Num operator ^{\wedge} (Num ^{\wedge}, 11 k)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               rep(i, 0, K) c.a[(i + k) % K] = a.a[i];
const int _p = 998244353;
11 add(11 x, 11 y) { x += y; return x%_p;
11 mul(11 x, 11 y) { return x*y%_p; }
11 Pow(11 x, 11 k) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                          Num(int x = 0) { mem(a, 0), a[0] = x; inline Num& operator = (const Num &t)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           inline void print(string s = "") {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               printf("\n\n\n\s\n", s.c_str())
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(i, 0, K) a[i] = t.a[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      o`
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      K) c.a[i]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   K) rep(j,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           inline 11 Value() {
```

```
int ret = 0, B = 1;
for (; \times || y; \times /= K, y /= K, B *= K) ret += (\times%K + y%K) % K*B;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               rep(i, 0, n) rep(j, 0, n) (C[get(i, j)] += mul(A[i], B[j])) %= rep(i, 0, n) C[i] < 0 ? C[i] += _p : 0;
                                                                                                                                                                                                                                                                                                            .;
o
                                                                                                                                                                                                                                                                         FWT(a, \ 0, \ n, \ -1); \ l1 \ inv = Pow(n, \ -p - 2);  rep(i, 0, n) C[i] = mul(a[i], inv), C[i] < 0 ? C[i] += _p
tmp[j] = add(tmp[j], mul(a[S + L*k + i], w[t]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            3 进制的,进制要整除模数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      void Multiply_B(ll A[], ll B[], int n, ll C[]) {
                                                                                                                                               void Multiply(11 A[], 11 B[], int n, 11 C[])
rep(i, 0, n) a[i] = A[i], b[i] = B[i];
FWT(a, 0, n, 1), FWT(b, 0, n, 1);
rep(i, 0, n) a[i] = mul(a[i], b[i]);
                                                          rep(j, 0, K) a[S + L*j + i] = tmp[j],
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         // wo 表示单位根模域表示,默认是
                                                                                                                                                                                                                                                                                                                                                                    int get(int x, int y) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           18 4138593
21 32705801
24 304035978
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     12 86475609
14 9196980
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          8 118835338
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   4 430477711
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  6 115381399
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         9 246325263
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     3 115381398
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                95932470
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         1000000000
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                .
0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               FWT(a, 0, n, 1), FWT(b, 0, n, 1); rep(i, 0, n) a[i] = a[i] * b[i]; FWT(a, 0, n, -1); ll inv = Pow(n, \_p - 2); rep(i, 0, n) C[i] = mul(a[i].Value(), inv), C[i] < 0 ? C[i] += \_p
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            void Multiply_B(11 A[], 11 B[], int n, 11 C[]) {
    rep(i, 0, n) rep(j, 0, n) (C[get(i, j)] += mul(A[i], B[j])) %= _p;
    rep(i, 0, n) C[i] < 0 ? C[i] += _p : 0;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   for (; \times || y; \times /= M, y /= M, B *= M) ret += (\times%M + y%M) % M*B;
                                                                                                                                            if (n == 1) return; int L = n / M;
rep(i, 0, M) FWT(a, S + L*i, n / M, op);
rep(i, 0, L) {
    rep(j, 0, M) tmp[i] = 0;
    rep(j, 0, M) rep(k, 0, M) {
        t = op*j*k&M, t < 0 ? t += M : 0;
        tmp[j] = tmp[j] + (a[S + L*k + i] >> t);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       void Multiply(11 A[], 11 B[], int n, 11 C[])
rep(i, 0, n) a[i] = A[i], b[i] = B[i];
                                                        struct FT {
    Num<K> tmp[M << 1], a[N], b[N]; int t;
    void FWT(Num<K> a[], int S, int n, int op) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            模域
                                                                                                                                                                                                                                                                                                                                                                                                rep(j, 0, M) a[S + L^*j + i] = tmp[j];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         xor 版本
                              template <int M, int N, int K>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int get(int x, int y) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            k 讲题
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    int ret = 0, B = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            FWT
```

子集卷积 \mathbf{FWT} 7.11

14 467509451

for (; k; k >>= 1, x = mul(x, x)) **if** (k & 1) ret = mul(ret, x);

template <int N, int K>

const int $_{p}$ = (int)1e9 + 9, w0 = 11538139811;

7.10

11 add(11 x, 11 y) { x += y; return x%_p; } 11 mul(11 x, 11 y) { return x*y%_p; } 11 Pow(11 x, 11 k) {

11 ret = 1;return ret;

4 86583718

7 14553391 998244353

```
struct Num {
                                                        void Init(11 w0) { w[0] = 1; rep(i, 1, K) w[i] = mul(w[i - 1], w0); }
void FWT(11 a[], int S, int n, int op) {
                                                                                                                                                                                                                 rep(j, 0, K) tmp[j] = 0;
rep(j, 0, K) rep(k, 0, K) {
t = op*j*k%K, t < 0 ? t += K : 0;
                     11 tmp[K << 1], a[N], b[N], w[K]; int t;</pre>
                                                                                                                                                    rep(i, 0, K) FWT(a, S + L*i, n / K, rep(i, 0, L) {
                                                                                                                       if (n == 1) return; int L = n / K;
struct FT {
```

```
inline int mul(int x, int y) { return (11)x^*y\%P; } inline int add(int x, int y) { return (x += y) >= P ? x - P : x;
                                                                                                                                                                                                                                                                                                                                     inline int operator [] (int x) const { return a[x]; }
                                                                                                                                                                                                                                                                                              inline int& operator [] (int x) { return a[x]; }
const int P = 1e9 + 7, M = 18;
                                                                                                                                                                                                                                                       array<int, L> a;
                                                                                                                                                                     template <int L>
```

T kpow(T a, T b) {T r=1;for(;b;b>>=1,a=mul(a,a)) {if(b&1)r=mul(r,a);}return r;} void calc(int n, T *a, T *b) {

T al[N], bl[N], c[N]; T add(T a, T b) {a = (a + b) % P; return a < 0 ? a + P : a;} T mul(T a, T b) {a = 111 * a * b % P; return a < 0 ? a + P : a;}

static const int N = 30, P = 1e9 + 7;

fill_n(c, n+1, 0); rep(i, 0, n+1) rep(j, 0, 2) c[i+j] = add(c[i+j], mul(a[i], b[j]));

memcpy(a, c, **sizeof**(a[0]) * (n+1));

void solve(**int** n, T *x, T *y, T *a){ // $a[\theta]^*x^{\lambda}\theta$... $a[n]^*x^{\lambda}n$

fill_n(a, n+1, 0); rep(i, 0, n+1) { fill_n(a1, n+1, 0); a1[0] = 1;

rep(\overline{j} , 0, n+1) if (\overline{j} != \overline{i}) a1[0] = mul(a1[0], x[\overline{i}] - x[\overline{j}]); a1[0] = mul(y[\overline{i}], kpow(a1[0], P - 2)); rep(\overline{j} , 0, n+1) if (\overline{j} != \overline{i}) { b1[0] = -x[\overline{j}]; b1[1] = 1;

rep(j, 0, n+1) a[j] = add(a[j], a1[j]);

calc(n, a1, b1);

```
* M 为 pit 数, 数组范围 [0,2^M—1] , Num 范围 [0,M]
* 多组数据, L 可改造用以减少计算量
                                                                                                                     * In 装箱操作, 将普通数组封装成集合幂级数
* Out 拆箱操作, 将集合幂级数转化为普通数组
                                                                      * 集合幂级数用于计算快速子集卷积
Calculator<Num<M + 1>> T;
                                                                                                                                                                                             * Pow 计算多重子集自卷积
                                                                                                                                                                       * Mu1 计算子集卷积
```

inline friend Num operator * (const Num &a, const Num &b)

rep(i, 0, L) a[i] = add(a[i], P - b[i]);

inline void operator -= (const Num &b) {

inline void operator += (const Num &b) {

inline void clear() { a.fill(0); }

rep(i, 0, L) a[i] = add(a[i], b[i]);

染色多项式 ${ m FWT}$ 7.12

```
inline int mul(int x, int y) { return (11)x * y % P; } inline int add(int x, int y) { if ((x += y) >= P) \times -= P; return \times < 0 ? \times + P : x; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  const int P = 1e9 + 7, M = 20; int L;
                                                                                                                                                                                                                                                                                       template<class T>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     struct vec {
                                                                                                                                                                                                                                                                                                                         struct Poly{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       void Mul(int A[], int B[], int len, int C[]) {
   In(A, len, aa), In(B, len, bb), mul(aa, bb, len, aa), Out(aa, len, C);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(i, 0, len) a[i].clear(), a[i][__builtin_popcount(i)] = A[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               void Pow(int A[], int len, int k, int C[]) {
   In(A, len, aa), pow(aa, len, k, bb), Out(bb, len, C);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     void Out(V a[], int len, int A[]) {
    rep(i, 0, len) A[i] = a[i][__builtin_popcount(i)];
                                                                                                                                                                                                                                                                                                                                               V aa[1 << M], bb[1 << M];
void fwt(V a[], int len, int o = 1) { // o=-1 UFWT
                                                                  for (int j = 0; i + j < L; ++j) if (b[j])
c[i + j] = add(c[i + j], mul(a[i], b[j]));</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         (o == 1) ? a[j] += a[i] : a[j] -= a[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           rep(j, 0, k-1) c[i] = c[i] * a[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      void pow(V a[], int len, int k, V c[]) {
                                                                                                                                                                                                                                                                                                                                                                                                               for (int k = 0; 1 << k < len; ++k)
rep(i, 0, len) if (-i >> k & 1) {
  int j = i ^ (1 << k);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              void mul(V a[], V b[], int len, V c[])
fwt(a, len), fwt(b, len);
rep(i, 0, len) c[i] = a[i] * b[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       rep(i, 0, len) a[i] = add(a[i], P);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   void In(int A[], int len, V a[]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    void ModP(int a[], int len)
Num<L> c; c.clear();
rep(i, 0, L) if (a[i])
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        fwt(a, len);
rep(i, 0, len) {
    c[i] = a[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      fwt(c, len, -1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                fwt(c, len, -1);
                                                                                                                                                                                                                                                                                                                    struct Calculator {
                                                                                                                                                                                                                                                                                  template <class V>
                                                                                                                                               return c;
```

inline void clear() { fill_n(a, L, 0); }
inline void operator += (const vec &b) { rep(i, 0, L) a[i] = add(a[i], b[i]); }
inline void operator == (const vec &b) { rep(i, 0, L) a[i] = add(a[i], -b[i]); }
inline vec operator *= (const vec &b) {

rep(i, 0, L) **if** (a[i])

vec c; c.clear();

inline int& operator [] (int x) { return a[x]; } inline int operator [] (int x) const { return a[x]; }

int a[M];

```
1}
                                                             -12, 13,
                                                                                                                                                       { 0, 0, 0, 6, 192, 1620, 7680 }
                                                             4,
                                                                                                                                                                          13
                                                            x (x-1)^{\lambda}2 (x-2)^{\lambda}2 = \{0,
                                          { 0, 0, 0, 12, 144, 720 }
                                                                                                                                                                          6
                                                                                                                                                                          32,
                                                                                                                                                                         {0, -16, 48, -56, */
                                                      Chromatic Poly
                                                                                                                                                                   Chromatic Poly
                                                                        Graph: link
                                    Color Ways
                                                                                                                                                 Color Ways
ω 4 4 4 4
                                                                                    μ ω ω ω ω α α α ω ω
7
            700
                                                                              9 7 0
                                                                                                      40000
```

Fib

```
// sum(fib[1..n]) + 1=fib[n + 2]
// gcd(fib[n], fib[m]) = fib[gcd(n, m)]
```

Fraction

```
Fra operator + (const Fra &c) const { return Fra(a * c.b + b * c.a, b * c.b); }
                                                                                                                     stringstream ss(s); char c;
                                                                                                                                                                                                                                                                                                               if(b < 0) a = -a, b = -b;
                                                                                                                                                                                                              Fra(T c): a(c), b(1) {}
Fra(T_a, T_b) {
T d = __gcd(_a, _b);
a = _a / d, b = _b / d;
                                                                  Fra(): a(0), b(1) {}
                                                                                                                                             ss >> a >> c >> b;
*this = Fra(a, b);
                                                                                           Fra(string s) {
template<class T>
                        struct Fra{
                                                та, b;
```

```
7.14
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   7.13
                                                                                                                                                                                                                                                                                                                                                                                  L = k + 1;
rep(i, 0, len) a[i].clear(), a[i][_builtin_popcount(i)] = mask[i];
fwt(a, len), ret[0] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int a[N], mask[1 << M], col[N], ret[N], n, m, u, v, X[N], Y[N];</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            else rep(i, 0, len) b[i] *= \tilde{a}[\tilde{i}];

int &t = ret[j] = 0;

rep(i, 0, len) if (__builtin_parity((len - 1) ^ i))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       t = add(t, -b[i][k]); else t = add(t, b[i][k]);
                                                                                                                                                                          void fwt(vec a[], int len, int <math>o = 1) { // o=-1 UFWT
                       c[i + j] = add(c[i + j], mul(a[i], b[j]));
                                                                                                                                                                                                                                                                                                                                                       void pow(int mask[], int len, int k, int ret[]) {
for (int j = 0; i + j < L; ++j) if (b[j])
                                                                                                                                                                                                                                                                                                                                                                                                                                                           for (int k = 0; 1 << k < len; ++k)
rep(i, 0, len) if (-i >> k & 1) {
  int j = i ^ (1 << k);
  o == 1 ? a[j] += a[i] : a[j] -= a[i];</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             void solve(int a[], int n) {
    mask[0] = 1; int L = 1 << n;
    rep(i, 1, L) {
    int t = i & -i, k = __builtin_ctz(t);
    mask[i] = mask[i ^ t] & !(i & a[k]);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    T.pow(mask, L, n, col);
rep(i, 0, n+1) X[i] = i, Y[i] = col[i];
                                                                                                                       struct cal {
   vec a[1 << M], b[1 << M];</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     PP.solve(n, X, Y, ret);
                                                   return *this = c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                cin >> u >> v;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        a[u] |= pw(v);
a[v] |= pw(u);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 0, m) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      int main() {
    cin >> n >> m;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            const int N = 50;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   solve(a, n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  Poly<int> PP;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       Graph: link
5 6
0 2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             cal T;
```

```
GaussInt
                                                                                                                                                                                                                                                                                                                                                namespace GaussInt{
                            }
return 0;
                                                                                                                                                                                                                                          7.16
          b * c.b); }
Fra operator — (const Fra &c) const { return Fra(a * c.b — b * c.a, b Fra operator * (const Fra &c) const { return Fra(a * c.a, b * c.b); } Fra operator / (const Fra &c) const { return Fra(a * c.b, b * c.a); } Fra operator / (const T &c) const { return Fra(a * c.b, b * c.a); } Fra operator / (const T &c) const { return Fra(a * c, b); } bool operator == (const Fra &c) const { return Fra(a, b * c); } bool operator != (const Fra &c) const { return a == c.a && b == c.b; } bool operator != (const Fra &c) const { return !(*this == c); } void print() { cout << a < "/" << b; }
                                                                                                                                                                                                                                                                                                                                                                                                                             typedef Fra<ll> fll;
```

7.15 GaussDB

```
for(k = col = 0; k < equ && col < var; ++k, ++col){
    p = k; rep(i, k+1, equ) if(fabs(a[i][col]) > fabs(a[p][col])) p = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    rep(j, i+1, var) if (fabs(a[i][j]) > eps) t \rightarrow x[j] * a[i][j];
                                                                                                                                                                                                             int pre = var; fnum = 0;
per(i, 0, k) {
    rep(j, 0, var) if (fabs(a[i][i]) > eps) { p = j; break; }
    rep(j, 0, i) if (fabs(a[i][p]) > eps) {
                                                                                                                                                                                                                                                                                                                                                                                                                                               .'d
=
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             rep(i, k, equ) if (fabs(a[i][var]) > eps) return -1;//无解
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if (p != k) rep(j, col, var+1) swap(a[p][j], a[k][j]);
                                                                                                                                                                                                                                                                                                                                                                                                                                       rep(j, p+1, pre) free[fnum++] = j, x[j] = (?); pre
                                                                                                                                                                                                                                                                                                                                                                           rep(1, p, var+1) a[j][1] -= a[i][1] * t;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    db t = a[i][col] / a[k][col];
rep(j, col, var+1) a[i][j] -= a[k][j] * t;
                                                       db a[N][N], x[N]; //增广矩阵和解集
int free[N], fnum, k, col, p; // 一组合法自由变元
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(fabs(a[k][col]) < eps) {k--; continue;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    rep(j, p+1, var) x[p] -= a[i][j] * x[j];
x[p] /= a[i][p];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(i, k+1, equ){
    if (fabs(a[i][col]) < eps) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   rep(j, 0, pre) free[fnum++] = j;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    return var — k;//自由变元个数
                                                                                                                                                                                                                                                                                                                                              db t = a[j][p] / a[i][p]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int Gauss(int equ, int var){
                             static const int N = 505;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      x[i] = t / a[i][i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   per(i, 0, var) {
   db t = a[i][var];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                         x[p] = a[i][var];
                                                                                                                    const db eps = 1e-14;
                                                                                                                                                                                        void genx(int var) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            // genx(var);
namespace GaussDB{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if(k < var){
```

```
int kpow(int a, int b) {int r=1;for(;b;b>>=1,a=mul(a,a)) {if(b&1)r=mul(r,a);}return r
                               int a[N][N], x[N]; //增广矩阵和解集
int free[N], fnum, k, col, p; // 一组合法自由变元
int add(int a, int b) {if ((a += b) >= P) a -= P; return a < 0? a + P: a;}
int mul(int a, int b) {return 111 * a * b % P;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(j, i+1, var) if (a[i][j]) t = add(t, -mul(a[i][j], x[j]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    rep(1, p, var+1) a[j][1] = add(a[j][1], -mul(a[i][1], t));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          rep(j, p+1, var) x[p] = add(x[p], -mul(a[i][j], x[j]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if (p != k) rep(j, col, var+1) swap(a[p][j], a[k][j]);
if(!a[k][col]) {k—; continue;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     rep(j, p+1, pre) free[fnum++] = j, x[j] = (?); pre =
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            for(k = col = 0; k < equ && col < var; ++k, ++col){
p = k; rep(i, k, equ) if (a[i][col]) {p = i; break;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(i, col, var+i) a[k][i] = mul(a[k][i], inv);
rep(i, k+1, equ) if (a[i][col]) {
                                                                                                                                                                                                                                                                                                                                           per(i, 0, k) {
    rep(j, 0, var) if (a[i][j]) { p = j; break;
    rep(j, 0, i) if (a[j][p]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          rep(i, k, equ) if (a[i][var]) return –1;//无解
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int inv = kpow(a[k][col], P - 2);
static const int N = ::N, P = 1e9 + 7;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            rep(j, 0, pre) free[fnum++] = j;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 return var — k;//自由变元个数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int Gauss(int equ, int var){
                                                                                                                                                                                                                                                                                                         int pre = var; frum = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      int t = a[i][col],
                                                                                                                                                                                                                                                                                                                                                                                                                                            int t = a[j][p];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int t = a[i][var];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     x[p] = a[i][var];
                                                                                                                                                                                                                                                                            void genx(int var) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  per(i, 0, var) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 //genx(var);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         x[i] = t;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if(k < var){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return 0;
```

7.19 LinearBasis

```
void ins(11 \times)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                bool Q(11 x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                           x^=a[i];
                                                                                                                                                                                                                                         const int M=32;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                return 1;
                        const int M=63
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return 0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             const int M=33
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     11 a[M];
                                                                  11 a[M];
                                           struct LB{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                11 tmp[M];
                                                                                                                                                                                                                                                           struct LB{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      struct LB{
                                                                                                        //有 equ 个方程, var 个变元。增广矩阵行数为 equ 列数为, [0.var]
                                                                                                                                                                                              int free[N], frum; //一组合法自由变元(多解枚举自由变元可以使用)
//返回值为 —1 表示无解,为 Θ 是唯一解,否则返回自由变元个数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    rep(i, 0, equ) if (i != k && a[i][col]) a[i] ^= a[k];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                               rep(i, 0, fnum) x[free[i]] = (msk >> i) & 1;
per(i, 0, k) {
    rep(j, 0, var) if(a[i][j]) { p = j; break; ]
    x[p] = a[i][var];
                                                                                                                                                                                                                                                                                                                                                    rep(j, p+1, var) x[p] \wedge = (a[i][j] \&\& x[j]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        rep(j, i+1, var) x[i] ^= (a[i][j] && x[j]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   k—; free[fnum++] = col;//这个是自由变元
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               rep(i, k, equ) if (a[i][var]) return -1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             rep(i, col, var) free[fnum++] = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if (p != k) swap(a[k], a[p]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              return var — k;//自由变元个数
                                                                                                                                                                            int p, col, k; // k 为增广矩阵的秩
                                                                                                                                 bitset<N> a[N]; //增广矩阵 modif
                                                                                          static const int N = 2e3 + 10;
                                                                                                                                                                                                                                                                                                                                                                                                                                         int Gauss(int equ, int var){
                                                                                                                                                                                                                                         void genx(int msk, int var)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               per(i, 0, var){
   x[i] = a[i][var];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if (!a[k][col]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              // genx(0, var);
GaussXor
                                              //对 2 取模的 01 方程组
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            continue
                                                                                                                                                        int x[N]; //解集
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if(k < var) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           //唯一解,回代
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return 0;
7.17
```

7.18 LikeEuclid

```
return (b/c)*n+(a/c)*n*(n-1)/2+(a%c?ca1(c,(a*n+b)%c,a%c,(a%c*n+b%c)/c):0);
ll cal(ll a,ll b,ll c,ll n) { // sum_{i=0...n-1}floor((a^{+i+b)/c})
                                                          if(n == 0) return 0;
```

```
11 Qry(int 1,11 x=0) { per(i,0,M) if (id[i]>=1) x=max(x,x^a[i]); return x; } B[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if (a[i]) x^{-a}[i], y^{-t}[i]; else { a[i]=x, tmp[i]=y; return 1; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             // 化为最简型,方便线性空间的 hash
void build () { per(i,0,M) per(j,0,i) a[i]=min(a[i],a[i]^a[j]); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     void Copy(const LB &L) { rep(i,0,M) a[i]=L.a[i],id[i]=L.id[i]; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       LB AA; 11 y, z; AA.Copy(A), C.Clear(); mem(tmp,0); per(i,0,M) if (B.a[i]) if (!AA.I(B.a[i],y)) C.I(y,z);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               else if (no>id[i]) swap(a[i], x), swap(id[i], no);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            ll almj,
LB() { mem(a,0); }
void Clear() { mem(a,0); }
void Copy(LB &A) { rep(i,0,M) a[i]=A.a[i]; }
void Copy(LB xA) { rep(i,0,M) a[i]=A.a[i]; }
                                                                                                                                                                                                                                                                     if (a[i]) x^=a[i]; else { a[i]=x; break; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for (int i=M-1; ~i && x; —i) if (x>>i&1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      For (int i=M-1; \sim i \& x; \longrightarrow i) if (x>>i\&1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             for(int i=M-1; \sim i \&\& x; \longrightarrow i) if (x>>i\&1)
                                                                                                                                                                                                                            for(int i=M-1; \sim i & x \times i - i) if (x>>i&1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    friend void Intersect(LB &A,LB &B,LB &C) {
                                                                                                                                                       void Clear() { memset(a, 0, sizeof(a)); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  void Clear() { memset(a, 0, sizeof(a)); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if (a[i]) x^=a[i]; else return 0;
                                                                                                                                                                                                                                                                                                                                                                              // 可持久化线性基 ( 序列前缀最右线性基
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if (!a[i]) a[i]=x,id[i]=no;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           void Ins(LB &L, ll x, int no) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         11 a[M]; int id[M];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  // 集合线性基求交与查询
// 普通集合线性基
```

```
LinearRecursion
;;
```

```
for(ll x = 0, W = n? 111<<(63 - __builtin_clzll(n)) : 0; W; W >>= 1, x <<=1) {
                                                                                                                                                                                                                                                                                                                                                                                 per(i, m, 2^*m) rep(j, 0, m) (u[i - m + j] += c[j] * u[i]) %= P;
                                                                                                                                                                                                                                                                                                                                                    rep(i, 0, m) \ rep(j, 0, m) \ (u[i + b + j] += v[i] * v[j]) \% = P;
                                   int linear_recurrence(ll n, int m, vi a, vi c) {
// a_{m} = \sum_{j=0}^{4} -m1a_{j} = (j)^{c} (m^{21gn})
                                                                                                                                                                                                                                                                                                                                                                                                                                                          copy(u.begin(), u.begin() + m, v.begin());
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              rep(i, 0, m) (ans += v[i] * a[i]) %=
                                                                                                                                                                                                                                                int b = !!(n & W); if(b) x++;
                                                                                                      vector<ll> v(m, 0), u(m<1, 0);
                                                                      if (n<m) return (a[n]+P)%P;</pre>
                                                                                                                                                                                                                                                                                      if(x < m) u[x] = 1;
                                                                                                                                                                                                          fill(all(u), 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       return (ans+P)%P
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              11 \text{ ans} = 0;
                                                                                                                                            V[0] = 1;
                                                                                                                                                                                                                                                                                                                   else {
```

MathFunction 7.21

```
int n, M, f[N], g[N], h[N], phi[N], u[N], p[N];
// f[n] 为 n 的最小质因子 ; g[n]=f[n]^/k; phi[n] 为欧拉函数 ; u[n] 为莫比乌斯函数 ; h[n] 为一
                                                                                                                                                                                                                                                                                                                                   for (int j = 1, k; j <= M && p[j] <= f[i] && i * p[j] <= n; j++){
  f[k = i * p[j]] = p[j];
  if (p[j] < f[i]) {</pre>
                                                                                                                              u[1]=phi[1]=1,h[1]=(0); // 1 的时候特判rep(i, 2, n+1) {
if (!f[i]) {
                                                                                                                                                                                                                                                                                                                                                                                                        g[k] = p[j];
phi[k] = phi[i] * phi[p[j]];
u[k] = u[i] * u[p[j]];
h[k] = h[i] * h[p[j]];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   u[k] = 0;

h[k] = h[i / g[i]] * (0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      g[k] = g[i] * p[j];

phi[k] = phi[i] * p[j];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               > /* 质数次幂特判 */
                                                                                                                                                                                                                         f[i] = g[i] = i;
phi[i] = i - 1;
                                                                                                                                                                                                                                                                                         h[i] = (0);
} // 质数的时候特判
const int N = 1e6 + 7;
                                                                                                                                                                                                                                                                    u[i] = -1;
                                                                                                            void prime(int n) {
                                                                                                                                                                                                  p[++M]=i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    }e1se
                                                                    般积性函数
```

Polya

7.23

```
// phi[i*p[j]]=phi[i]*(p[j]<f[i]?phi[p[j]];p[j]);
                         // u[i*p[j]]=u[i]*(p[j]<f[i]?u[p[j]]:0);
                                                                     /*phi[i*j]=phi[i]*phi[j] (gcd(i,j)=1)
phi[i]*j (j|i)
                                                                                                                  u[i*j]=u[i\bar{j}*u[j] (gcd(i, j)=1)
                                                                                                                                                                                                                                                                                                                                   ij
                                                                                                                                                                                                                                                                                                                                    ٧
                                                                                                                                            0 (j|i)
                                                                                                                                                                                                                                                                                                                                   const int M = 1 \ll 17
                                                                                                                                                                    *
```

```
rep(i, 0, N) if (i < rev[i]) swap(a[i], a[rev[i]]);
for (int i = 1; i < N; i <= 1)
  for (int j = 0, t = N / (i << 1); j < N; j += i << 1)
  for (int k = 0, 1 = 0, x, y; k < i; k++, 1 += t)
  x = (11) w[f][1] * a[j+k+i] % P, y = a[j+k], a[j+k] = (y+x) % P, a[j+k+i]</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if (f) for (int i = 0, x = kpow(N, P-2); i < N; i++) a[i] = (11)a[i] * x % P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for (int i = 1, x = kpow(6, (P-1) / N), y = kpow(x, P-2); i < N; i++)
rev[i] = (rev[i>>1] >> 1) | ((i&1) << (d-1));
w[0][i] = (11)x * w[0][i-1] % P, w[1][i] = (11) y * w[1][i-1] % P;</pre>
                                                                                                                                                                                                                                       c * a %P;
                                                                                                static const int G = 3, P = 1004535809; //P = C*2^{\Lambda}k + 1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  void doit(int *a, int *b, int na, int nb){ // [0,
                                                                                                                                                                                                                                          ပ
                                                                                                                                                                                                                                  for (; b; b >>= 1,a = a * a % P) if (b & 1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 for (N = 1; N < na + nb - 1; N <<= 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              work(), FFT(a,0), FFT(b,0);
rep(i, 0, N) a[i] = (11)a[i] * b[i] % |
FFT(a, 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      //rep(i, 0, N) cout << a[i] << endl;
                                                                                                                               int N, na, nb, w[2][M], rev[M];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int d = __builtin_ctz(N);
w[0][0] = w[1][0] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          = (y-x+P) % P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     rep(i, na, N) a[i] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       rep(i, nb, N) b[i] = 0;
                                                                                                                                                                                                                                                                                                                                     void FFT(int *a, int f){
                                                                                                                                                                 11 kpow(11 a, int b){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             void work(){
int a[M], b[M];
                                                                                                                                                                                                        11 c = 1;
                                                                                                                                                                                                                                                                           return c;
                                                                   struct NTT{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               } ntt;
```

```
if (g == 1) continue;
if (g == n) for (g = 1, y = sy; g == 1; ) <math>y = add(mul(y, y), c), g = \_gcd(n)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 ull brent(ull n, ull c) \{ // n \text{ must be composite and odd.} \}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           for (int i = 0; i < 1; ++i) y = add(mul(y, y), c);
                                                            325, 9375, 28178, 450775, 9780504, 1795265022}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   .;
o
{2, 2570940, 211991001, 3749873356u},
{2, 2570940, 880937, 610386380, 4130785767u},
{2, 325, 9375, 28178, 450775, 9780504, 179526
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             for (int i = 0; i < min(s, 1 - k); ++i) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 for (uint j = i * i; j <= n; j += i) isp[j]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         for (uint i = 2; i <= sq; ++i) if (isp[i]) {
   if (i != 2) primes.pb(i);</pre>
                                                                                                                                                                                                                                                                                                                                                                (n < 3770579582154547) \times = y = 5;
                                                                                                                                                                                                                                                                                                                                         (n < 47636622961201) \times = y = 4;
                                                                                                                                                                                                                                                                                 else if (n < 4759123141) \times = 2, y = 3;
                                                                                                                                                                                                                                                                                                               (n < 154639673381) \times = y = 3;
                                                                                                                                                                                                                                                     else if (n < 19471033) \times = 1, y = 2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    y = add(mul(y, y), c);
p = mul(p, add(y, n - x));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                for (int k = 0; k < 1; k += s)
                                                                                                                                                                                                                                                                                                                                                                                                return !composite(n, base[x], y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    uint e = __builtin_ctzll(n);
                                                                                                                                                                                                                         if (n < 1373653) \times = 0, y = 2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   for (ull l = 1; ; l <<= 1) {</pre>
                                                                                                                                           2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             ull y = 1; c \% = n; mod = n;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      \sqrt{\ln (n+1, 1)}
                                                                                                                                             II
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    ull g = gcd(n, p)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           assert(n < (1ull << 63));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             vector<pli>factors(ull n)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        , add(y, n - x));
                                                                                                                                         if (!(n \& 1)) return n
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if (n <= 1) return {};</pre>
                                                                                                                                                                   if (n <= 8) return 1;</pre>
                                                                                   };
if (n <= 1) return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 const ull s = 256;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            uint sq = sqrt(n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 ull sy = y;
                                                                                                                                                                                                   int x = 6, y = 7;
                                                                                                                                                                                                                                                                                                                                                                                                                                                    vector<uint> primes
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               vector<pli>ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                ret.eb(2, e);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                void init(uint n) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if (!(n & 1)) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    primes.clear();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return g;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  ull p = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   ull \times = y;
                                                                                                                                                                                                                                                                                                          else if
                                                                                                                                                                                                                                                                                                                                         else if
                                                                                                                                                                                                                                                                                                                                                                  else if
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      for (j = s - 1; j > 0; --j) { a = mul(a, a); if (a == n - 1) break; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             bool is_prime(ull n) { // reference: http://miller-rabin.appspot.com
                                                                      首先列出所有可能的染色方案,然后找出每个置换下保持不变的方案(不动点)数。
等价类数目: 所有置换的不动点数的平均值。
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       for (; b; a = mul(a, a), b >>= 1) if (b & 1) res = mul(res, a);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  bool composite(ull n, const uint* base, int m) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ull k = ((long double)a * b / mod + 0.1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if (mod < int(2e9)) return a * b % mod;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if (a == 1 | | a == n - 1) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         inline ull sqr(ull x) { return x * x; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      for (int i = 0, j; i < m; ++i) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               {2, 3},
{2, 299417},
{2, 7, 61},
{15, 176006322, 4221622697u},
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int s = __builtin_ctzll(n - 1);
ull d = (n - 1) >> s; mod = n;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 static const uint base[][7] = \{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if ((a += b) >= mod) a -= mod;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            ull a = kpow(base[i], d);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               inline ull kpow(ull a, ull b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if ((11)res < 0) res += mod;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 inline ull add(ull a, ull b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    inline ull mul(ull a, ull b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           assert(n < (ull(1) << 63));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            ull res = a * b - k * mod;
                                                                                                                                                                                                                                                                                                                                             using ull = unsigned long long;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if (j == 0) return 1;
                                                                                                                                 Polya enumeration theorem
                                                                                                                                                                                                                                                                                                                   using uint128 = __uint128 t;
                                                                                                                                                                                                                                                                                                                                                                                                                                 using pli = pair<ull, uint>;
                                                                                                                                                                                                                                                                                                                                                                                                   using uint = unsigned int;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                #define eb emplace_back
                                                                                                                                                          * 一个循环的颜色需相同
                                                                                                                                                                                                                                                                                                                                                                       using 11 = long long;
                                                 Burnside's lemma
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               ull res = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      namespace prime {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       return res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                return a;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            return 0;
                                                                                                                                                                                                                                                \mathbf{Rho}
                                                                                                                                                                                                                                                7.24
```

```
rep(i, 1, m + 1) if (sgn(A[i][j]) > 0 && b[i] / A[i][j] < tmp) // 找基变量
r = i, tmp = b[i] / A[i][j];
                                                                                rep(j, 1, n+1) if (sgn(A[1][j]) < 0 && (e == -1 \mid | (rand() \& 1))) = j;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            // 贪心取最大如果矩阵为全幺模或 0 很多可以加上 break 因为转轴代价可能较小
                           rep(i, 1, m+1) if (sgn(b[i]) < 0 && (1 == -1 \mid | (rand() \& 1))) 1 = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if (delt < tmp ^* c[j]) l = r, e = j, delt = tmp ^* c[j];
                                                                                                                                                                                                                                                                                                                                                                                                               rep(j, 1, n + 1) if (sgn(c[j]) > 0) { // 找非基变量
                                                                                                                                                                                                                                                                           //if (!ini()) return —DINF; // 无解 b < 0 need ini()
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if (tmp == DINF) return DINF; // 无界
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if (e == -1) break; // 找到最优解
                                                                                                                                                                                                                                                                                                         rep(i, 1, n+1) ans[i] = 0;
                                                                                                            if(e == -1) return 0;
  int 1 = -1, e = -1;
                                                     if(1 == -1) break;
                                                                                                                                                                                                                                                                                                                                                                                                                                             db tmp = DINF;
                                                                                                                                                                                                                                                                                                                                                                int r, l, e = -1;
                                                                                                                                                                                                                                                                                                                                                                                          db delt = -DINF;
                                                                                                                                          pivot(l, e);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               pivot(1, e)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       break;
                                                                                                                                                                                                                                                                                                                                   while (1) {
                                                                                                                                                                                               return 1;
                                                                                                                                                                                                                                                    db run() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                           }
if (n > 1) ret.eb(n, 1);
if (sz(ret) - s >= 2) sort(ret.begin() + s, ret.end());
                                                                                                                                                                                                                                                                                                                                                            while (n % p == 0) n /= p, e++;
                                                                                                                6++;
                                                                                                                                                                                                                    while (n > lim && !is_prime(n)) {
                                                                                                                                                                                                                                                                                                     if (!is_prime(p)) continue;
ull lim = sqr(primes.back());
                                                                                                            while (n \% p == 0) n /= p,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    const db EPS = 1e-8, DINF = 1e15;
                                                                                                                                                                                                                                                  for (ull c = 1; ; ++c)
                                                                                                                                                                                                                                                                                ull p = brent(n, c);
                                                                                                                                                                                                                                                                                                                                   uint e = 1; n /= p;
                                                         if (sqr(p) > n) break;
                             for (auto &&p: primes)
                                                                                                                                          if (e) ret.eb(p, e);
                                                                                                                                                                                                                                                                                                                                                                                            ret.eb(p, e);
                                                                                                                                                                                             uint s = sz(ret);
                                                                                  uint e = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    Simplex
                                                                                                                                                                                                                                                                                                                                                                                                                      break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              return ret;
```

Simpson

} sb;

db v, ans[M], b[M], c[M], A[M][M]; // 全幺模矩阵可以改整数

static const int M = 550;

struct Simplex {

7.25

int n, m, B[M], N[M];

rep(i, 1, m+1) if (B[i] <= n) ans[B[i]] = b[i]; return v;

dp c) {

db a,

```
return asr(a, ab, b, esp / 2, L, fa, fab, fb) + asr(b, bc, c, esp / 2,
                                                                                                                                                                                                                                                                                                                                                                                                      db L = simpson(fa, fab, fb, a, b), R = simpson(fb, fbc, fc, b, c); if (fabs(L + R - A) <= 15 * esp) return L + R + (L + R - A) / 15.0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return asr(a, b, c, eps, simpson(fa, fb, fc, a, c), fa, fb,
                                                                                                                                                                                                                                                                                                      db asr(db a, db b, db c, db esp, db A, db fa, db fb, db fc) { db ab = (a + b) / 2, bc = (b + c) / 2; db fab = F(ab), fbc = F(bc);
                                                                                                                                  const db eps = 1e-10; // 精度感觉一般要多设 1e-3 左右
                                                                                                                                                                                                                                     return (fa + 4 * fb + fc) * (c - a) / 6;
                                                                                                                                                                                                   inline db simpson(db fa, db fb, db fc,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                db fa = F(a), fb = F(b), fc = F(c);
                                                                                                                                                              inline db F(db x) { F(x) = (?) }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          db asr(db a, db c, db eps) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              db \ b = (a + c) / 2;
                                                                                                     namespace Simpson {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             // f(a, c)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    fc);
                            7.26
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           rep(j, 1, n + 1) A[i][j] -= (j!=e) * A[i][e] * A[1][j]; // 可以链式优化
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              rep(i, 1, n + 1) c[i] -= (i!=e) * c[e] * A[1][i];
v += b[1] * c[e]; c[e] *= -A[1][e]; swap(B[1], N[e]);
                                                                                                                                                                                                                                                                                                           inline int sgn(db \ x) \ \{ \ return \ (x > EPS) - (x < -EPS); \ \} void pivot(int \ 1, \ int \ e) \ \{
                                                                                                                                                                                                                                                                                                                                                                                                                                           rep(i, 1, n + 1) if (i != e) A[1][i] /= tmp;
rep(i, 1, m + 1) if (i != 1 && sgn(A[i][e])) {
                                                                                                                                                                                                                                                                                                                                                                                                         b[1] /= tmp, \bar{A}[\bar{1}][e] = 1 / tmp;
                                                                                                                                                                                                                                     rep(i, 1, m + 1) B[i] = i + n;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               A[i][e] = - A[i][e] / tmp;
/* n- variables, m- equations
                                                                                                                                                                      n = \_n, m = \_m, v = 0;
rep(i, 1, n + 1) N[i] = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            b[i] -= A[i][e] * b[1];
                                                                                                                                    void init(int _n, int _m) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    bool ini(){ // 随机化初始解
                                                                                                                                                                                                                                                                                                                                                                          db tmp = A[1][e];
                                                                      * s.t.Ax <= b, x >= 0
                                    * maxf(x)=cx
```

fbc,

fb,

Α,

fc);

25

min

7.28

7.27 SternBrocotTree

```
static const int N = 1e6 + 7;
                                                                                                                                                                                                                                                                                                // 要求的积性函数 F(p ^ e)
                                                                                                                                                                                                                                        11 f(int p) { return 1;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               cntp = 0; isp[1] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       p[++cntp] = INT\_MAX;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          S(11 x, int y){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     void prime(int n){
                                                                                                                                                                                                            // f(p) = p \wedge k
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return ret;
                                                                                                                                                                              bool isp[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            1
                                                                                                                                                                                                                                                                                                                                                                                                                         pii operator+(const pii &a, const pii &b) { return mp(a.fi + b.fi, a.se + b.se); } pii operator*(const pii &a, U \times) { return mp(a.fi * x, a.se * x); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            pii solve(V v, U MAXB) { // find ROUND_HALF_UP(a / b) = v, b <= MAXB V L = mp(V.fi * 10 - 5, v.se * 10); V R = mp(V.fi * 10 + 5, v.se * 10); V R = mp(V.fi * 10 + 5, v.se * 10);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               U 1 = 0, r = f > 0? (hi.se? (MAXB - lo.se) / hi.se : INF)
                                                                                                                                                                           typedef pair<T, T> V; // V = [double|long double|fraction]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                bool search(V v, U MAXB, pii &lo, pii &hi, int f) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               }
db t1 = (db) lo.fi / lo.se;
db t2 = (db) hi.fi / hi.se;
db t3 = (db) v.fi / v.se;
if (t2 - t3 <= t3 - t1) return hi;else return lo;</pre>
                                                                                                                                                                                                                                                                                                                                   inline bool in(const V &a, const V &b, const V &c) return \theta <= cmp(c, a) && cmp(c, b) < \theta;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       r = f * cmp(x, v) <= 0? r : 1;

f > 0? 1o = 1o + hi * r : hi = 1o * r + hi;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          //V m = mp(lo.fi + hi.fi, lo.se + hi.se);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           //if (in(L, R, m)) return mp(m.fi, m.se);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         (lo.se? (MAXB - hi.se) / lo.se: INF);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               x = f > 0 ? 1o + hi * z : 1o * z + hi;

f * cmp(x, v) <= 0 ? 1 = z : r = z;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            x = f > 0? 10 + hi * r : 10 * r + hi;
                                                                                                                                                                                                            inline int cmp(const V &a, const V &b) {
    T x = a.fi * b.se - a.se * b.fi;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           hi, 1);
hi, -1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    //if (in(L, R, lo)) return lo;
//if (in(L, R, hi)) return hi;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         ok |= search(v, MAXB, lo, ok |= search(v, MAXB, lo,
                                                                                                                                                                                                                                                                    return (x > 0) - (x < 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    pii lo(0, 1), hi(1, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     U z = (1 + r) >> 1;
                                                                                   typedef pair<U, U> pii;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       while (1 + 1 < r) {
                         typedef long double db;
                                                                                                                    const U INF = 1e9 + 7;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  ok |= search(v,
if (!ok) break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                return mp(-1, -1);
                                                                                                                                                  typedef __int128 T;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                bool ok = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                while (true) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return r > 0;
                                                       typedef int U;
namespace SBT {
```

```
4 余 1 的质数个数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                11 ret = -(g[k] - sp[y-1]);// 质数的答案

for(int i = y; i <= tot && 111 * p[i] * p[i] <= x; i++){

11 t1 = p[i], t2 = 111 * p[i] * p[i];

for(int e = 1; t2 <= x; e++, t1 = t2, t2 *= p[i]) {

if (F(p[i], e)) ret += S(x / t1, i + 1) * F(p[i], e);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  // S[x][y] 表示 [2, x] 中最小质因子大于等于 p[y] 的 F(i) 的和
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            tot = upper_bound(p + 1, p + cntp + 1, Sqr) - (p + 1);
                                                             // 或者 F(i) 的质数位置前缀和能通过埃氏筛法 dp 求出,如求模
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 for(int j = 1; j <= cntp && i * p[j] <= n; j++){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    rep(i, 1, cntp+1) sp[i] = sp[i - 1] + f(p[i]);
                                                                                                                                                                                                                                                                                                                                                                11 F(int p, int e) { return e == 1 ? -1 : 0;}
                                                                                                                        int Sqr, m, p[N], id1[N], id2[N], tot, cntp;
11 g[N], sp[N], h[N], n, w[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    ret += F(p[i], e + 1);// 合数的答案
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if(x <= 1 || p[y] > x) return 0;
int k = (x <= Sqr ? id1[x] : id2[n/x]);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      // g[i] 表示 [2, w[i]] 中质数位置 f(i) 的和
                                                                                                                                                                                                                                                                                                                                                                                                                             // 假设都是质数的完全积性函数前缀和去掉
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if(i % p[j] == 0)break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 rep(i, 2, n+1) {
   if(!isp[i]) p[++cntp] = i;
struct Min_25{
// F(i) 要拆成多个完全积性函数的和
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        11 solve(11 _n) {
    n = _n;if (n == 0) return 0;
    m = 0;Sqr = sqrt(n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  isp[i * p[j]] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                 ll calc(ll n) { return n - 1;}
```

MATH

7

```
ac[0] = 1; rep(i, 1, n+1) fac[i] = mul(fac[i-1], i);
                                                          per(i, 0, n) ifac[i] = mul(ifac[i+1], i+1);
pre[0] = suf[n+1] = 1;
rep(i, 1, n+1) pre[i] = mul(pre[i-1], k - i);
per(i, 1, n+1) suf[i] = mul(suf[i+1], k - i);
                                                                                                                                                                                                                                                                                                                                                    ans = add(ans, mul(fg*s1, mul(s2, y[i]));
                                                                                                                                                                                                                                                                           T s2 = mul(ifac[i-i], ifac[n-i]);
T fg = (n-i)&1 ? -1 : 1;
                                                                                                                                                                                                                                                     T s1 = mul(pre[i-1], suf[i+1]);
                          [fac[n] = kpow(fac[n], P - 2);
                                                                                                                                                                                                                        rep(i, 1, n+1){
                                                                                                                                                                                                                                                                                                                                                                                                                   return ans;
                                                                                                                                                                                             r ans=0;
                                                                                                                                                                                                                   for(int i = 1; i <= m && 111 * p[j] * p[j] <= w[i]; i++){
    l1 t = w[i] / p[j];</pre>
                                                                                                                                                                                                                                                                                  int k = t <= Sqr ? id1[t] : id2[n / t];
g[i] -= f(p[j]) * (g[k] - sp[j - 1]);</pre>
                                                                                                                         w[m] \le Sqr ? id1[w[m]] = m : id2[j] = m;
For(11 i = 1, j; i \le n; i = j + 1){
                                                                                            g[m] = calc(w[m]);
                               j = n / (n / i);
                                                                                                                                                                                      rep(j, 1, tot + 1)
                                                                                                                                                                                                                                                                                                                                                                               return S(n,1) + 1;
                                                                 w[++m] = n / i;
```

polysum 7.30

ploynomial

```
11 add(11 a, 11 b) {a = (a + b) % P; return a < 0 ? a + P : a;}
11 mul(11 a, 11 b) {a = 111 * a * b % P; return a < 0 ? a + P : a;}
11 kpow(11 a, 11 b) {11 r=1;for(;b;b>>=1,a=mul(a,a)) {if(b&1)r=mul(r,a);}return r;}
void init(int M) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            il qpolysum(11 R, 11 n, 11 *a, 11 m) { // a[0].. a[m] \Sum_{i=0}^{i=0}^{l} a[i]^*R^i if (R == 1) return Polysum(n, a, m); a[m+1] = calcn(m, a, m+1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                Il Polysum(ll n, ll *a, ll m) { // a[\theta].. a[m] \setminus sum_{\{i=0\}} \setminus \{n-1\} \ a[i]
                                                                                                                                                                                                                                                                                      fac[0] = 1; rep(i, 1, M+5) fac[i] = mul(fac[i-1], i);
                                                                                                    11 a[D], fac[D], ifac[D], p1[D], p2[D], h[D][2], C[D];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         11 r = kpow(R, P - 2), p3 = 0, p4 = 0, c, ans;
                                                                                                                                                                                                                                                                                                                                                         per(i, 0, M+4) ifac[i] = mul(ifac[i+1], i+1);
                                                                                                                                                                                                                                                                                                                                                                                                                                  calcn(int d, 11 *a, 11 n) { // a[0].. a[d]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    ans = (d-i)&1 ? add(ans, -t) : add(ans,
                                                                static const int D = 101000, P = 998244353;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        rep(i, 1, m+2) a[i] = add(a[i-1], a[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       11 s1 = mul(p1[i], p2[d - i]);
11 s2 = mul(ifac[i], ifac[d - i]);
11 t = mul(mul(s1, s2), a[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      rep(i, 0, \bar{d}+\bar{1}) p1[i+1] = mul(p1[i], rep(i, 0, d+1) p2[i+1] = mul(p2[i], ll ans=0;
                                                                                                                                                                                                                                                                                                                           ifac[M+4] = kpow(fac[M+4], P - 2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               return calcn(m+1, a, n—1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    a[m+1] = calcn(m, a, m+1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             h[0][0] = 0; h[0][1] = 1; rep(i, 1, m+2) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if (n <= d) return a[n];</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        p1[0] = p2[0] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      rep(i, 0, d+1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               return ans;
                                    struct polysum {
                                                                                                                                                                                                                                             T kpow(T a, T b) {T r=1;for(;b;b>>=1,a=mul(a,a)) {if(b&1)r=mul(r,a);}return r;} void calc(int n, T *a, T *b) {
                                                                                                                                                                                                                                                                                                                                                    rep(i, 0, n+1) rep(j, 0, 2) c[i+j] = add(c[i+j], mul(a[i], b[j]));
memcpy(a, c, sizeof(a[0]) * (n+1));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(j, 0, n+1) if (j != i) a1[0] = mul(a1[0], x[i] - x[j]);
                                                                                                                                     Tal[N], bl[N], c[N], a[N], pre[N], suf[N], ifac[N], fac[N]; Tadd(Ta, Tb) {a = (a + b) % P; return a < 0 ? a + P : a; T mul(Ta, Tb) {a = 111 * a * b % P; return a < 0 ? a + P : a;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        rep(j, 0, n+1) if (j != i) s1 = mul(s1, k - x[j]);
rep(j, 0, n+1) if (j != i) s2 = mul(s2, x[i] - x[j]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                   void solve(int n, T *x, T *y){ // a[\theta]^*x^{\wedge}\theta ... a[n]^*x^{\wedge}n
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 res = add(res, mul(s1, kpow(s2, P - 2)));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      rep(j, 0, n+1) a[j] = add(a[j], a1[j]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   a1[0] = mul(y[i], kpow(a1[0], P - 2));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             } T get(int n, int k, T *y) { // x is [1..n]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                T get(int n, int k, T *x, T *y) { // f(k)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             fill_n(a1, n+1, 0); a1[0] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       rep(j, 0, n+1) if (j != i) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         b1[0] = -x[j]; b1[1] = 1;
                                                                     static const int N = 101010; static const int P = 998244353;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(i, 0, n+1) {
  T s1 = y[i], s2 = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             calc(n, a1, b1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        fill_n(a, n+1, 0);
                                                                                                                                                                                                                                                                                                                           fill_n(c, n+1, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               rep(i, 0, n+1) {
                                    struct polynomial{
template<class T>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return res;
```

(n-i) % P);(n-d+i) % P);

t);

48/89

inline vec3 operator + (int x) const{

vec3 r = *this;

```
== x) a[i].
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       inline void ini() { a[0].set(); a[1].reset(); a[2].reset(); }
inline void set(int p, int x) { x = (x % 3 + 3) % 3; rep(i, 0, 3) if (i) }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              inline int operator [] (int x) { rep(i, 0, 3) if (a[i][x]) return i; }
                                                                                                                                                                                                                                                                                                                                                                                                                                       for( ; i \le n; (j\&1) ? i+=2 : i+=4 , j++) if(bit[j] == 0) p[cntp++]=i;
                                                                                                                                                                           int i, j;
cntp = 2; p[0] = 2; p[1] = 3;
for(i = 5, j = 1; i * i <= n; (j & 1) ? i += 2 : i += 4 , j++) {
   if(bit[j] == 0) {</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | (a[2] & c.a[2]);
| (a[1] & c.a[1]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           int getval() { return (a[1].count() + a[2].count() * 2) % 3; } inline vec3 operator * (const vec3 &c) const {
                                                                                                                                                                                                                                                                                                                                                       = 1;
                                                                                                                                                                                                                                                                                                                   for(int j = i * i; j <= n ; j += i)
if(j % 2 != 0 && j % 3 != 0) bit[j / 3]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    r.a[1] = (a[0] & c.a[1]) | (a[1] & c.a[0]) |
r.a[2] = (a[0] & c.a[2]) | (a[2] & c.a[0]) |
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          r.a[1] = (a[1] \& c.a[1]) | (a[2] \& c.a[2]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                inline vec3 operator + (const vec3 &c) const
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                inline vec3 operator - (const vec3 &c) const
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       r.a[2].set(); r.a[2] ^= r.a[0] ^ r.a[1]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       if (x == 0) { r.ini(); }
if (x == 2) { swap(r.a[1], r.a[2]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   inline vec3 operator * (int x) const {
                               const int N = 3e8 + 6, M = 2e7 + 6;
// 优化埃氏筛法空间最小可以不存质数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   set(p); else a[i].reset(p); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           r.a[0] ^= r.a[1] ^ r.a[2],
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               return (*this) + (c * -1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                r.a[0] = a[0] | c.a[0];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       static const int N = ::N;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            x = (x \% 3 + 3) \% 3;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 vec3() { a[0].set(); }
                                                                                    bitset<N /3+1> bit;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     三进制向量
                                                                                                                                              void getprime(int n){
                                                                                                                                                                                                                                                                                               p[cntp++]=i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    vec3 r = *this;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    bitset<N> a[3];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         return r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        return r;
                                                            int cntp, p[M];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            struct vec3{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              7.32
                                                                                                                                            p3 = i & 1 ? add(p3, _mul(h[i][0], t)) : add(p3, mul(h[i][0], t));
p4 = i & 1 ? add(p4, _mul(h[i][1], t)) : add(p4, mul(h[i][1], t));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         void getprime(int N) {
    cntp = 2;p[0] = 2;p[1] = 3;
    for (int i = 5, k = 1; i <= N; (k & 1) ? i+=2 : i+=4 , k++){</pre>
                                                                                                                                                                                                                                                           rep(i, 0, m+2) h[i][0] = add(h[i][0], h[i][1] * c);
rep(i, 0, m+2) C[i] = h[i][0];
ans = add(mul(calcn(m, C, n), kpow(R, n)), -c);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  for (int j = 2; j < cntp && p[j] * i <= N; j++)
// low[p[j] * i] = p[j];</pre>
  h[i][0] = mul(h[i-1][0] + a[i-1], r); \\ h[i][1] = mul(h[i-1][1], r);
                                                                                    rep(i, 0, m+2) {
    ll t = mul(ifac[i], ifac[m+1—i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            for (int j=0;j<cntp&&p[j]*i<N;j++){
    //low[p[j] * ij = p[j];
    isp[p[j] * i] = 0;
    if (i % p[j] == 0) break;</pre>
                                                                                                                                                                                                                              = mul(kpow(p4, P - 2), -p3);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            const int N = 3e7 + 6, M = 2e6 + 6;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if(i\%p[j] == \overline{0}) break
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                isp[p[j] * i / 3] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               // 优化版欧拉筛法 bitset 需要 02
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    fill_n(isp + 2, N - 2, 1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          // Iow[i] = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        const int N = 1e6 + 6;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           // int low[N], bitset<N / 3 + 1> isp;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               p[cntp++]=i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int low[N], cntp, p[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if (!isp[k]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 // low[] : optional
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        void getprime() {
                                                                                                                                                                                                                                                                                                                                                         return ans;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                    \operatorname{prime}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int cntp,p[M];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    // time : O(n)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  bool isp[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                      7.31
```

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MATH
Fuzhou University
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               rep(i, 0, phi) if (__gcd((11)i, phi) == 1) ret.pb(kpow(g, i, p));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        Η,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if (p == 1 || p == 2 || p == 4) return phi = p + 1 >> 1,
                                                                                                                                                                                                         inline bool check_g(ll g, ll p) { rep(i, 0, sz(P)) if (kpow(g, P[i], p) == 1) return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        for (g = 1; \_gcd(g, p) != 1 || !check\_g(g, p); ++g);
                                                                             for (; k; k >>= 1, x = x^*x\%) if (k & 1) ret = ret*x\%p;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if (sz(P) > 2 \mid \mid sz(P) = 1 \& P[0] == 2) return 0;
if (sz(P) == 1) return 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if (P[0] != 2 || P[0] == 2 && A[0] > 1) return
                                                                                                                                                                                                                                                                                                                                      P.clear(), A.clear(); for (11 k = 2; k^*k \le m; ++k) if (m%k == 0)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for (auto t : P) phi = phi / t^*(t-1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           //if (m==1 || m==2 || m==4) return 1;
                                                                                                                                                                                                                                                                                                                                                                                                                while (m%k == 0) m /= k, cnt++;
P.pb(k), A.pb(cnt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 vector<11> ret; 11 g = getRoot(p);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    inline vector<ll>> getAllRoot(ll p)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for (auto &t : P) t = phi / t;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if (m > 1) P.pb(m), A.pb(1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           sort(all(ret)); return ret
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if (!check(p)) return -1;
                                                                                                                                                                               vector<ll>P, A; ll phi, g;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if (g == -1) return ret;
                                                                                                                                                                                                                                                                                                          inline void factor(ll m) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           inline 11 getRoot(11 p) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 inline bool check(11 m)
                           kpow(11 x, 11 k, 11 p)
                                                                                                                                                                                                                                                                                                                                                                                      int cnt = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 带权拟阵交
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          factor(phi);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     factor(m);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return g;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           return 1;
                                                                                                                                                                                                                                                              return 1;
                                                                                                                                                       struct Euler {
                                                       11 ret = 1;
                                                                                                         return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     7.36
                           Π
                                                                                                                                                                                                                                                                                                          inline int add(int a, int b) { if((a += b) >= P) a \rightarrow= P; return a < 0 ? a + P : a;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             f[i] = add(f[i], j & 1 ? f[i – fv[j] – j] : –f[i – fv[j] – j]);
                               if (x == 1) { swap(r.a[2]); swap(r.a[1], r.a[2]); } if (x == 2) { swap(r.a[0], r.a[2]); swap(r.a[0], r.a[1]); }
                                                                                                                                                                                                                                                                                                                                                                                                            rep(i, 1, m+1) fv[i] = i * (3 * i - 1) / 2;
rep(i, 2, n+1) {
  for(int j = 1; fv[j] <= i; j++) {
    f[i] = add(f[i], j & 1 ? f[i - fv[j]] : -f[i - fv[j]]);
  if (fv[j] + j <= i)</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      inline bool check_g(11 g, 11 p) {
    rep(i, 0, sz(c)) if (Pow(g, c[i], p) == 1) return 0;
    return 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            for (; k; k >>= 1, x = x^*x%p) if (k & 1) ret = ret*x%p;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     for (11 k = 2; k^*k <= tmp; ++k) if (tmp % k == 0)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     }
if (tmp != 1) c.pb(tmp);
rep(i, 0, sz(c)) c[i] = (p - 1) / c[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           while (tmp \% k == 0) tmp /= k;
                                                                                                                                                                                                                                                      const int N = 1e6 + 5, P = 998244353;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             inline ll getRoot(ll p)
```

11 Pow(11 x, 11 k, 11 p)

11 ret = 1;

原根

7.34

struct Euler {
 vector<ll> c;

return ret;

int m = sqrt(n) + 1;

f[0] = f[1] = 1;void init(int n) {

int n, f[N], fv[N];

赵分数

7.33

 $= (\times \% \ 3 + 3) \% \ 3;$

return r;

小 7.35

return g;

11 tmp = p - 1, g;

c.clear();

c.pb(k);

tot, tot2;

E,

_`

int c[N], k[N], col[N], u[N], v[N], w[N], sum, ans, T,
struct GM {
 vi g[N]; bool vis[N], exist[N];

void dfs(int u) {

vis[u] = 1;

const int N = 85, INF = pw(30);

```
if (sz(res.fi) != sum || !gm.test(res.fi)) cout << -1 << endl;
else cout << ans - res.se << endl;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                           if (!inq[v]) q.push(v), inq[v] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             while (la != S) has[la] ^{-1} 1, la = pre[la];
                                               rep(j, 1, n+1) if (!has[j] && i != j) {
                                                                                                                                                                                                                                                                        while(!q.empty()) {
   int u = q.front(); q.pop(); inq[u] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if (!pre[T]) return mp(getcur(), ans);
                                                                                               if (mt1.test(tmp)) g[i].pb(j);
if (mt2.test(tmp)) g[j].pb(i);
                                                                                                                                                                                                                                                                                                                           for(auto v : g[u])
if(d[v] < d[u] + cost[v]) {
    d[v] = d[u] + cost[v];</pre>
                                                                                                                                                                                                                                                   d[S] = 0; q.push(S); inq[S] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        u[tot] = 1, v[tot] = r + 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     cin >> 1 >> r >> cost;
                                                                                                                                               tmp.pop_back();
                          vi tmp = getcur();
                                                                                                                                                                                                                                                                                                                                                                                                pre[v] = u;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            rep(i, 1, m+1) {
cin >> c[i] >> k[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                sum += c[i] - k[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               col[++tot] = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               int 1, r, cost;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       rep(j, 0, c[i]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              tot = ans = sum = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   w[tot] = cost;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            auto res = mi.run();
                                                                        tmp.pb(j);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int la = pre[T];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 MI<GM, CM> mi(tot);
 has[i] ^= 1;
                                                                                                                                                                                                 has[i] ^= 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            ans += cost;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             ans += d[T];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            //hdu 6636 Milk Candy
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       cin >> n >> m;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     rep(cas, 0, T) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 GM gm;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            cin >> T;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int main() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int n, S, T, pre[N], d[N], cost[N]; bool inq[N], has[N]; vi g[N]; queue<int> q;
MI(int n) : n(n) {}
                                                                                                                      for(auto x : vec) exist[x] = 0;
rep(i, 1, tot+1) if (exist[i]) g[u[i]].pb(v[i]), g[v[i]].pb(u[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                       rep(i, 1, m+1) if(cnt[i] > c[i] - k[i]) return 0; return 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          vi tmp = getcur();
if (mt1.test(tmp)) g[S].pb(i); // X1
if (mt2.test(tmp)) g[i].pb(T); // X2
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      memset(has, 0, sizeof(has));

S = n + 1, T = n + 2, cost[S] = cost[T] = 0;

while (1) {
                                             bool test(vi &vec) {
    rep(i, 1, n+2) g[i].clear(), vis[i] = 0;
for(auto v : g[u]) if (!vis[v]) dfs(v);
                                                                                                                                                                          dfs(1);
rep(i, 1, n+2) if(!vis[i]) return 0;
return 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            rep(i, 1, n+1) if(has[i]) ret.pb(i);
                                                                                                                                                                                                                                                                                                                                                                           memset(cnt, 0, sizeof(cnt));
for(auto x : vec) cnt[col[x]]++;
                                                                                                 memset(exist, 1, sizeof(exist));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 1, n+1) if (has[i]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         } else cost[i] = -w[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               11 ans = 0; MT1 mt1; MT2 mt2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            while(!q.empty()) q.pop();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           template <class MT1, class MT2>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(i, i, n+3) {
   inq[i] = pre[i] = 0;
   d[i] = -INF;
   g[i].clear();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        cost[i] = w[i];
```

void clear() {

struct MI {

bool test(vi &vec) {

int cnt[125];

struct CM {

has[i] ^= 1;

rep(i, 1, n+1) { **if**(!has[i]) {

clear();

pair<vi, 11> run() {

return ret;

vi getcur() {

vi ret;

has[i] $^{\wedge}=1$;

tot2, k; ll val[N], x;

int col[N], n, m, tot,
struct LM { // 线性拟阵

11 base[63];

const int N = 5005;

LM() { memset(base, 0, sizeof(base)); } void add(ll x) {

per(j, 0, 63) **if** ((x >> j) & 1){

else $\times \wedge = base[j];$

if (!x) break;

base[j] = x;

break

if(!base[j])

```
rep(i, 1, n+1) if (sink[i] \& vis[i]) { has[i] \land = 1; ok = 1; break;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              else for(auto x : res) if (col[x] > n) cout << val[x] << endl;
                                                                                                            vector<MT1> vmt1(sz(cur)); vector<MT2> vmt2(sz(cur));
                                                                                                                                                                                                                                                                                                                                                                                                 if (sink[u]) { t = u; break;}
rep(v, 1, n+1) if (!vis[v] && has[u] != has[v]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if(vmt1[id[u]].test(val[v])) push(v, u);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if(vmt2[id[v]].test(col[u])) push(v, u);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              rep(j, 0, k) cin >> x, val[++tot] = x, col[tot] = tot2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     <u>.</u>`
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   rep(i, 0, n) cin >> x, val[++tot] = x, col[tot] = ++tot2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for (; b; b >>= 1, a = a * a % P) if (b & 1) r = r * a %
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 //In real cases, Linear Matroid Need Optimization to Pass
                                                                                                                                         rep(i, 0, sz(cur))
rep(j, 0, sz(cur)) if (i != j)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           while (t) has[t] ^{-1}, t = pre[t];
                                                                                                                                                                                               vmt1[i].add(val[cur[j]]);
vmt2[i].add(col[cur[j]]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if (sz(res) < n + m) cout << -1 << end1;
                                                                                                                                                                                                                                                                                                                                                                     int u = q.front(); q.pop();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if (t == -1) return cur;
                                                                                                                                                                                                                                                                                                                                          while(!q.empty()) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                     if(has[u])
                                                      if (ok) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           MI<LM, CM> matint(tot);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            else {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       vi res = matint.run();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        11 kpow(11 a, 11 b, 11 P)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        cin >> k; tot2++;
bool ok = 0;
                                                                                                                                                                                                                                                                                                              int t = -1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         //Pick Your Own Nim
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        离散对数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              rep(i, 0, m) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              cin >> n;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    cin >> m;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               int main() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      11 r = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           7.38
```

int n, pre[N], id[N]; bool vis[N], sink[N], has[N]; queue<int> q; $MI(int\ n)\ :\ n(n)\ \{\}$

.,

||

CM() { memset(cnt,0,sizeof(cnt)); }
void add(int x) { cnt[x]++; }

struct CM { // 高维均匀拟阵

int cnt[125];

bool test(**int** \times) { **return** cnt[\times]

};
template <class MT1, class MT2>

struct MI {

rep(i, 1, n+1) vis[i] = sink[i] = pre[i]

void clear() {

while (!q.empty()) q.pop();

vi getcur() {

vi ret;

if(!base[j]) return 1; else x ^= base[j];

if (!x) break;

return 0;

bool test(11 x) {
 per(j, 0, 63) if ((x >> j) & 1){

```
for(auto \times : cur) mt1.add(val[x]), mt2.add(col[x]);
                                                                                                                                 if(mt1.test(val[i])) push(i, 0); // X1;
if(mt2.test(col[i])) sink[i] = 1; // X2;
                                                                                                  rep(i, 1, n+1) if (!has[i])
vi cur = getcur(); clear();
                                    MT1 mt1; MT2 mt2;
```

void push(**int** v, **int** p) { vis[v] = 1, pre[v] = p, q.push(v); }

memset(has, 0, **sizeof**(has));

while(1) {

MT1 mt1; MT2 mt2;

vi run() {

rep(i, 1, n+1) **if** (has[i]) ret.pb(i), id[i] = sz(ret) - 1;

return ret;

7

rep(i, 0, sz(P)) if (kpow(g, P[i], p) == 1) return 0;

return 1;

phi_phi; BSGS T;

struct Euler {
 v11 P, A, _P, _A; 11 phi, g, phi
 inline bool check_g(11 g, 11 p)

typedef pair<ll, 11> pll;

typedef vector<ll> vll;

} crt;

P.clear(), A.clear(); for (11 k = 2; k*k <= m; ++k) if (m%k == 0) {

int cnt = 0;

inline void factor(ll m, vll &P, vll &A)

= (R % M + M) % M; // 可能为 Ø 看是否需要是正整数

M = M / g * mod[i];

return R;

```
111 t = 1 \% P, w = 1, ans, c = 0; z \% P;
rep(i, 0, 51) { if (t == z) return i; t = t * x % P; }
for (t = __gcd(x, P); t != 1; t = __gcd(x, P)) {
    ۳,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        ||] g = __gcd(M, mod[i]);
||l inv = Inv(M / g, mod[i] / g);
||if ((a[i] - R) % g) return -1; // 充解
||R += inv * ((a[i] - R) / g) % (mod[i] / g) * M;
    sa %
return i * sq + M[res]; else res = res *
                                                                                  il ex_bsgs(ll x, ll z, ll P) { //x^y==z(mod P)
                                                                                                                                                                                                                                                                                                                       z = z * Inv(w, P) % P, ans = bsgs(x, z, P);
return ans + (ans != -1) * c;
                                                                                                                                                                                                                                  z /= t, P /= t, w = w * x / t % P, C++
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if (b == 0) { x = 1; y = 0; return; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            void exgcd(ll a, 11 b, 11 &x, 11 &y)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                    11 M, R; static const int N = 55;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return x < 0? x + mod : x;
                                                                                                                                                                                                    if (z % t) return -1;
                                                                                                                                                                                                                                                                 if (z == w) return c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    exgcd(b, a % b, y, x);
y == a / b * x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  M = mod[1], R = a[1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   exgcd(a, mod, x, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             rep(i, 2, n + 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             11 Inv(11 a, 11 mod)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      11 \times = 0, y = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 11 a[N], mod[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          }
11 solve(11 n) {
                                   return -1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  ; pow =% ×
                                                                                                                                                                                                                                                                                                                                                                                                                                         struct CRT {
                                                                                                                                                                                                                                                                                                                                                                                                              rep(i, 0, sq + 1) { if (M.count(t)) break; M[t] = i, t = t * \times % P; }
                             b ? (ex_gcd(b, a \% b, y, x), y = a / b * x) : (x = 1, y = 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 0, 51) { if (t == z) return i; t = t * x % P; } for (t = \_gcd(x, P); t != 1; t = gcd(x, P)) {
                                                                                                                                                                                                                                                                                                                                                                                 11 res = z % P, sa, t = 1, sq = sqrt(P); M.clear();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 return i * sq + M[res]; else res = res * sa % P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           gcd(x, P); t != 1; t = gcd(x, P)) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 ex_bsgs(l1 x, l1 z, l1 P) { //x^y==z(mod P) l1 t = 1 % P, w = 1, ans, c = 0; z %= P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            z /= t, P /= t, w = w * x / t % P, C++;
                                                                                                                                                                                                                                                                                                                                                                                                                                       t = P / sq, sa = Inv(kpow(x, sq, P), P);
rep(i, 0, t + 1) if (M.count(res))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        = z * Inv(w, P) % P, ans = bsgs(x, z, et v)
  void ex_gcd(int a, int b, int &x, int &y) {
                                                                                                                                               int x, y; ex_gcd(a, P, x, y);
                                                                                                                                                                                                                                                                                                                                                 if(x % P) == 0) return -1;
                                                                                                                                                                                                                                                                                            unordered_map<11, int> M;
11 bsgs(11 x, 11 z, 11 P) {
                                                                                                                  inline int Inv(int a, int P) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   return ans + (ans i = -1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if (z == w) return c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if (z \% t) return -1;
                                                                                                                                                                              return x < 0 ? x + P : x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return -1;
                                                                                                                                                                                                                                                                 struct BSGS {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           71
```

小 高次同余 7.39

```
if (x % P == 0) return -1;
11 res = 2 % P, sa, t = 1, sq = sqrt(P); M.clear();
rep(i, 0, sq + 1) { if (M.count(t)) break; M[t] = i, t = t * x % P; }
                                                                                                                                                                               (0 =
                                                           ď,
                                                      for (; b; b >>= 1, a = a * a % P) if (b & 1) r = r * a %
                                                                                                                                                                               = 1, y
                                                                                                                                                                           b \ge (ex\_gcd(b, a \% b, y, x), y = a / b * x) : (x
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     t = P / sq, sa = Inv(kpow(x, sq, P), P);
rep(i, 0, t + 1) if (M.count(res))
                                                                                                                                               void ex_gcd(ll a, ll b, ll &x, ll &y) {
                                                                                                                                                                                                                                                                    11 x, y; ex_gcd(a, P, x, y);
                                                                                                                                                                                                                                                                                                                                                                                 map<11, int> M;
11 bsgs(11 x, 11 z, 11 P) {
                           11 r = 1; assert(b >= 0);
                                                                                                                                                                                                                                                                                               return x < 0? x + P: x;
11 kpow(11 a, 11 b, 11 P) {
                                                                                                                                                                                                                                    inline 11 Inv(11 a, 11 P) {
                                                                                                                                                                                                                                                                                                                                                        struct BSGS {
                                                                                        return r;
```

rep(i, 0, sz(P)) P[i] = phi / P[i];

if (!check(p)) return -1;

inline 11 getRoot(11 p) {

return 1;

() ()

۳,

```
11 _g = t.se, x = t.fi, ans = kpow(g, x, p), d = kpow(g, _p / _g, p), ret = _g; if (ok) ans *= t2, ret *= t3;
                                                                                                                                                                                                                                                                       // solve equation: x^{\Lambda}a=b(%p), p could not be a prime, but p must have a primitive
                                                                                                                                                                                                                                                                                                                                                                                                                                           factor(p, _P, _A); int tot = sz(_P); 11 ret = 1, ans; pll tmp[32];
rep(i, 0, tot) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 tmp[i + 1] = solve_high(a, b, _P[i], _A[i]),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      crt.mod[i + 1] = get\_pow(\_P[i], \_A[i])
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  // 注:返回 pair( 最小非负解 , [0,p) 中解的个数
                                                             pair<ll, ll> t = solve(a, _b, _p);

if (t.fi == -1) return mp(-1, 0);
                                                                                                                                                                                                                                                                                                                                            pll solve_high(ll a, ll b, ll p) {
if (_b == -1) return mp(-1, 0);
                                                                                                                                                                                                                                                                                                               root, that is 8 cannot divide p
                                                                                                                                                                                                                                                                                                                                                                                                              if (p == 1) return mp(0, 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   crt.a[i + 1] = tmp[i + 1]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if (!ret) return mp(-1, 0);
                                                                                                                                                                                                                                                                                                                                                                            assert(p > 0); norm(b, p);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        ret *= tmp[i + 1].se;
                               11 _{p} = p / pp^{*}(pp - 1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                ans = crt.solve(tot);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     质数
                                                                                                                                                                                                            return mp(ans, ret);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return mp(ans, ret);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  高次同余
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          7.40
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if (p == 1 || p == 2 || p == 4) return phi = p + 1 >> 1, phi_phi = 1, p - 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       for (g = 1; \_gcd(g, p) != 1 || !check\_g(g, p); ++g);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 factor(m, P, A);

if (sz(P) > 2 \mid \mid sz(P) == 1 \& \& P[0] == 2) return 0;

if (sz(P) == 1) return 1;

if (P[0] := 2 \mid \mid P[0] == 2 \& \& A[0] > 1) return 0;
                                                                                                                                                                       11 p) \{ x = (x\%p + p) \% p;
                                                                                                                                                                                                                                                                       // for (auto t:P) phi=phi/t*(t-1);
rep(i, 0, sz(P)) phi = phi / P[i] * (P[i] - 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             phi = get_phi(p);
factor(phi, P, A), phi_phi = get_phi(phi);
// for (auto &t:P) t=phi/t;
                                                                                                                                                                                                                                                                                                                                                                                                                                                 //if (m==1 || m==2 || m==4) return 1;
```

while (m%k == 0) m /= k, cnt++;

P.pb(k), A.pb(cnt);

} if (m > 1) P.pb(m), A.pb(1);

inline 11 get_phi(11 p) {

11 phi = p;

inline void norm(11 &x,

inline bool check(ll m) {

return phi;

```
b : (ex_gcd(b, a \% b, y, x), y = a / b * x) : (x = 1, y = a / b * x)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for (; b; b >>= 1, a = a * a % P) if (b & 1) r = r * a %
                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if (x % P == 0) return -1;
11 res = 2 % P, sa, t = 1, sq = sqrt(P); M.clear();
rep(i, 0, sq + 1) { if (M.count(t)) break; M[t] = i,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return i * sq + M[res]; else res = res * sa %
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              t = P / sq, sa = Inv(kpow(x, sq, P), P);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 0, t + 1) if (M.count(res))
                                                                                                                                                                           void ex_gcd(ll a, ll b, ll &x, ll &y) {
                                                                                                                                                                                                                                                                                           11 x, y; ex_gcd(a, P, x, y); return x < 0 ? x + P : x;
                                                                                                                                                                                                                                                                                                                                                                                                                                           11 bsgs(11 x, 11 z, 11 P) {
                                                                                                                                                                                                                                                                inline 11 Inv(11 a, 11 P) {
                                 11 kpow(11 a, 11 b, 11 P) {
                                                          11 r = 1; assert(b >= 0)
                                                                                                                                                                                                                                                                                                                                                                                                                  map<ll, int> M;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        return -1;
                                                                                                                                                                                                                                                                                                                                                                                     struct BSGS {
                                                                                                                       return r;
                                                                                                                                                                                                 return mp(kpow(a, phi_phi - 1, p)*b%p, g);//note that phi_phi
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     (cnt) t1 = get_pow(pp, cnt), t2 = get_pow(pp, cnt / a), t3 = t1 / t2, ok = 1, p /= t1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        11 p = get_pow(pp, k); norm(b, p); 11 t1, t2, t3;
if (!a) return b == 1 ? mp(0, p) : mp(-1, 011);
if (!b) return mp(!a, get_pow(pp, k - (k - 1) / a - 1));
11 g = getRoot(p);
if (g == -1) return mp(-1, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        int cnt = 0; while (b%pp == 0) b /= pp, cnt++; if (cnt%a) return mp(-1, 0); bool ok = 0;
                                                                                                                                                                                                                                                                                                                                                                                 } // solve equation: x^a=b(\%pp^\lambda k), pp is a prime
                                                                                                            norm(a, p); norm(b, p); ll g = \_gcd(a, p);
                                                                                                                                                                                                                                                                                                                                                                                                                                       pll solve_high(ll a, ll b, ll pp, int k) {
                                                   // solve equation: ax=b(\%p), gcd(a,p)!=1 pll solve(ll a, ll b, ll p) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                  assert(pp > 1), assert(k > 0);
                                                                                                                                                                                                                                                            get_pow(11 p, int k) {
11 ret = 1; assert(k >= 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               b = T.ex_bsgs(g, b, p);
                                                                                                                                           if (b%g) return mp(-1, g);
                                                                                                                                                                                                                                                                                                                    rep(i, 0, k) ret = ret*p;
                                                                                                                                                                    /= g, b /= g, p /= g;
                                                                                                                                                                                                                                                                                                                                                   return ret;
return g;
                                                                                                                                                                                                                                   7
```

 $t = t * \times %$

ď,

```
11 _g = t.se, x = t.fi, ans = kpow(g, x, p), d = kpow(g, _p / _g, p),
                                                         return mp(kpow(a, phi_phi - 1, p)*b%p, g);//note that phi_phi
                                                                                                                // solve equation: x^{\wedge}a=b(\%p), p must be a prime vll solve_high(ll a, ll b, ll p) { vll ret; norm(b, p); assert(p > 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        rep(i, 1, _{-g}) ans = ans*d%p, ret.pb(ans);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   // 注 : 返回所有 [0,p) 中的非负整数解
                                                                                                                                                                                                                                                                                                                                                                                                                                    if (t.fi ==-1) return ret,
if (b%g) return mp(-1, g);
                                                                                                                                                                                                                                                                                                                                                                                                     pll t = solve(a, _b, _p);
                                                                                                                                                                                                                                                                                                                                              if (_b == -1) return ret,
                                                                                                                                                                                                                                                                                      if (g == -1) return ret;
                                                                                                                                                                                                                                                                                                                   _b = T.bsgs(g, b, p);
                            a /= g, b /= g, p /= g;
                                                                                                                                                                                                    if (!a == b) ret.pb(0);
                                                                                                                                                                                                                               if (!b) return ret;
                                                                                                                                                                                                                                                            11 g = getRoot(p);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              sort(all(ret));
                                                                                                                                                                                                                                                                                                                                                                            11_p = p - 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                ret.pb(ans);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    return ret;
```

struct Euler {
 v11 P, A; 11 phi, g, phi_phi; BSGS T;
 inline bool check_g(11 g, 11 p) {
 rep(i, 0, sz(P)) if (kpow(g, P[i], p) == 1) return 0;
 return 1;

typedef vector<ll> vll;
typedef pair<ll, ll> pll;

for (11 k = 2; $k^*k \le m$; ++k) if (m%k == 0)

inline void factor(ll m) {

P.clear(), A.clear();

while (m%k == 0) m /= k, cnt++;

int cnt = 0;

P.pb(k), A.pb(cnt);

if (m > 1) P.pb(m), A.pb(1);

for (t = __gcd(x, P); t != 1; t = __gcd(x, P)) {
 if (z % t) return -1;
 z /= t, P /= t, w = w * x / t % P, c++;

= bsgs(x, z,

return ans + (ans != -1) * c;

= z * Inv(w, P) % P, ans

if (z == w) return c;

Others

 ∞

8.1 BitOperation

inline void norm(11 &x, 11 p) { x = (x%p + p) % p; }
inline 11 get_phi(11 p) {
11 phi = p;

for (**auto** t : P) phi = phi / $t^*(t-1)$;

```
int _builtin_ffsll (unsigned low long) Returns one plus the index of the least significant 1—bit of x, or if x is zero, returns are plus the index of the least significant 1—bit of x, or if x is zero, returns are plus the index of the least significant 1—bit of x, or if x is zero, returns are plus the index of the least significant 1—bit of x, or if x is zero, returns are plus the least significant 1—bit of x, or if x is zero, returns are plus the least significant 1—bit of x, or if x is zero, returns are plus the least significant 1—bit of x, or if x is zero, returns are plus the least significant 1—bit of x, or if x is zero, returns are plus the least significant 1—bit of x, or if x is zero, returns are plus the least significant 1—bit of x, or if x is zero, returns are plus the least significant 1—bit of x, or if x is zero, returns are plus the least significant 1—bit of x, or if x is zero, returns are plus the least significant 1—bit of x, or if x is zero, returns are plus the least significant 1—bit of x, or if x is zero, returns are plus the least significant 1—bit of x is zero, returns are plus the least significant 1—bit of x is zero, returns are plus the least significant 1—bit of x is zero, returns are plus the least 1 and 
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          rep(i, 0, n) {
    for(int j = (1 << n) - 1; -j; -j) if(!(j >> i & 1)) {
        upd(s[j], s[j | (1 << i)]);
}
                                                                                                                                                                                                                                                                                                                                                                                                                                      rep(i, 0, n) {
    rep(j, 0, 1 << n) if(j >> i & 1) {
        upd(s[j], s[j ^ (1 << i)]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int __builtin_ffs (unsigned int x)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int __builtin_clz (unsigned int x)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      int __builtin_ffsl (unsigned long)
                                                                                                         for(int i = x; i; (—i) & x) {
                                                                                                                                                                                                                                                                                                                                                              // 统计子集的答案
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             // 统计超集的答案
             // 枚举子集
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         inline 11 getRoot(11 p) {
   if (p == 1 || p == 2 || p == 4) return phi = p + 1 >> 1, phi_phi = 1, p - 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      // rep(i, \theta, sz(P)) P[i]=phi/P[i];

for (g = 1; __gcd(g, p) != 1 || !check_g(g, p); ++g);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if (sz(P) > 2 | | sz(P) == 1 \& P[0] == 2) return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if (sz(P) == 1) return 1;
if (P[0] != 2 || P[0] == 2 && A[0] > 1) return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  norm(a, p); norm(b, p); ll g = \_gcd(a, p);
rep(i, 0, sz(P)) phi=phi/P[i]*(P[i]-1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                // solve equation: ax=b(\%p), gcd(a,p)!=1 pll solve(ll a, ll b, ll p) {
                                                                                                                                                                                                                                                                                                                                                //if (m==1 || m==2 || m==4) return 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                factor(phi), phi_phi = get_phi(phi);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                for (auto &t : P) t = phi / t;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if (!check(p)) return -1;
                                                                                                                                                                                                                                                           inline bool check(ll m) {
                                                                                            return phi;
                                                                                                                                                                                                                                                                                                                                                                                                                                      factor(m);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       return 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               return g;
```

```
while(sz(ch) && pri(ch.back()) >= pri(c)) rpn.pb(ch.back()), ch.pop_back();
                                                                                                                                                                                                                 reverse(all(ch)); rpn.insert(rpn.end(), all(ch));
// 后缀表达式计算
                                    } else if(pri(c) > 0) {
                                                                                                                                        } else { rpn.pb(c); }
                                                                                                                                                                                                                                                                                                                           rep(i, 0, sz(rpn)) {
ch.pop_back();
                                                                                                                                                                                                                                                                                                                                                               char u = rpn[i];
if(pri(u) > 0) {
                                                                                                       ch.pb(c);
                                                                                                                                                                                                                                                                                         sta.clear();
Returns the number of leading 0—bits in x, starting at the most significant bit position ||
                                                                                                                                           Returns the number of trailing 0—bits in x, starting at the least significant bit
                                                                                                                                                                                                                                                                                                                                                                                                 Returns the parity of x, i.e. the number of 1-bits in x modulo
                                                                                                                                                                             position. If x is \theta, the result is undefined
                                                                                                                                                                                                                                                     int __builtin_popcount (unsigned int x)
                                                                                                                                                                                                                                                                                                                                                            __builtin_parity (unsigned int \times)
                                 . If x is 0, the result is undefined.
                                                                                                       __builtin_ctz (unsigned int \times)
                                                                                                                                                                                                                                                                                         Returns the number of 1-bits in x.
```

8.4 I

b.count(); // cnt of 1

b.none();

Base b.any();

>

// has 1 ? // all 0 ?

Bitset

8.2

```
char wbuf[S];
                                struct FastIO {
                                                                      int wpos;
                                                                                                           bool ed;
                                                                                                                                                                                                                                                                     for (int i = b._Find_first(); i < sz(b); i = b._Find_next(i));</pre>
                                                                                                                                    b.flip(p); // b[p] = 0 <-> 1
                                         7
                                      b.flip(); // all = 0 <->
                                                                                                                                                                                        __builtin_ctz in bitst
                                                                            b.set(p); // b[p] = 1
b.test(p); // b[p] is 1
                    b.reset(); // all to 0
                                                                                                                 b.reset(p);// b[p] = 0
// all to 1
                                                                                                                                                                                                                b._Find_first();
                                                                                                                                                                                                                                                  // travel all 1
                                                                                                                                                                         Black tech
 b.set();
                                                                                                                                                                           >
```

8.3 ExpressionParse

FastIO

return sta[0];

sta[sz(sta) - 1] = calc(u, sta.back(), b);
} else { sta.pb(u); }

char b = sta.back(); sta.pop_back();

```
.
.
.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                .
.
.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 for (; '0' <= c && c <= '9'; c = xchar()) x = x * 10 + c
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              For (; '0' <= c && c <= '9'; c = xchar()) x = x * 10 + c
                                                                                                                                                                                                                                                             if (pos == len) pos = \theta, len = fread(buf, 1, S, stdin);
if (pos == len) return -1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             while (c <= 32) c = xchar();
for (; c > 32; c = xchar()) *s++ = c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if (c == '-') s = -1, c = xchar();
                                                                                                                                                                                                                                                                                                                                                                                                = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int c = xchar(), x = 0;
while (c <= 32) c = xchar();</pre>
                                                                                                                                                                                                                                 static int len = \vec{0}, pos = \vec{0};
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       inline void xstring(char *s) {
                                                                                                                                                                                                                                                                                                                                                                                                                                              if(!\sim c) return ed = 1;
                                                                                                                                                      FastIO() : wpos(0), ed(0) { }
                                                    static const int S = 1310720
                                                                                                                                                                                                                                                                                                                                                                                              int c = xchar(), x = 0,
                                                                                                                                                                                                         static char buf[S];
                                                                                                                                                                                                                                                                                                                return buf[pos++];
// read untill EOF (xint)
                                                                                                                                                                               inline int xchar() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                inline int xuint() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int c = xchar();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                             c = xchar();
                                                                                                                                                                                                                                                                                                                                                                                                                    while (c <= 32)
                                                                                                                                                                                                                                                                                                                                                                    inline int xint() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return × * s;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          return x;
```

```
List<String> mylist2 = new LinkedList<>();
                                                                                                                                                                                                                                                                                                                                                                                     _ist<String> mylist1 = new ArrayList<>();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                Jueue<String> que = new LinkedList⇔();
                                                                                                                                                                                                                                                                                                                                                                                                                                                  List<String> mylist3 = new Vector<>();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   /ector<String> vec = new Vector<>();
                                                                                                                                      public static void main(String[] args)
                                                                                                                                                                          Scanner cin=new Scanner(System.in);
                                                                                                                                                                                                      BigInteger a=cin.nextBigInteger();
                                                                                                                                                                                                                                       BigInteger b=cin.nextBigInteger();
                                                                                                                                                                                                                                                                   System.out.println(a.add(b))
                                                                                                                                                                                                                                                                                                                              a=cin.nextInt();
                                                                                                                                                                                                                                                                                                                                                             b=cin.nextInt();
                                               import java.util.*;
                                                                                import java.math.*;
                                                                                                            public class code
                                                                                                                                                                                                                                                                                                  Integer a,b;
                       import java.io.*;
                                                                                                                                                                                                                                                                                                                                                                                                                           ~FastIO() { if (wpos) fwrite(wbuf, 1, wpos, stdout), wpos = 0; }
                                                                                                                                                                                                                                                                                                                                                                                                 inline void wstring(const char *s) { while (*s) wchar(*s++); }
                                                                                         .
0
                                                                                     if (wpos == S) fwrite(wbuf, 1, S, stdout), wpos =
                                                                                                                                                                                                                                                                                                         + \times \% 10, \times /= 10
                                                                                                                                                                                                           if (x < 0) wchar('-'), x = -x;
                                                                                                                                                                                                                                                                                                       while (x | | !n) s[n++] = '0'
                                                                                                                                                                                                                                                                                                                                 while (n—) wchar(s[n]);
                                                             inline void wchar(int \times) \{
                                                                                                                                                                                 inline void wint(int x)
                                                                                                                   wbuf[wpos++] = x;
                                                                                                                                                                                                                                         char s[24];
                                                                                                                                                                                                                                                                             int n = 0;
*s = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                              } io;
```

Rand 8.7

if (wb == 32) len = 31 -__builtin_clz(n - 1) + wb; else len = 63 -__builtin_clzl1(n - 1) + wb;

if $(n == 1) \times = 1$, len = 0;

else {

FastD(T1 n): m(n) {

FastD() = default; int len; T1 m, x;

const static int wb = sizeof(T1) * 8;

template<class T1, class T2>

struct FastD

FastMod

8.5

x = ((T2(1) << len) + n - 1) / n;

dap<String, Integer> mymap2 = new TreeMap<>() Map<String, Integer> mymap = new HashMap<>();

Set<String> myset = new HashSet<>();

Stack<String> sta = **new** Stack<>();

Set<String> myset2 = **new** TreeSet<>()

```
ll rnd(ll l, ll r) \{ RR dis(l, r); return dis(gen);
                                                                                                                                                                                                  db rnd(db 1, db r) { RR dis(1, r); return dis(gen);
                                                                                                                                          typedef uniform_real_distribution<db> RR;
                                           typedef uniform_int_distribution<ll> RR;
mt19937 gen(998244353);
                                                                                                                                                                      friend T1 operator / (const T1 &n, const FastD &d) { return T2(n) * d.x >> d.len; } friend T1 operator % (const T1 &n, const FastD &d) { return n-n/d*d.m; }
```

RomanNumerals ∞ ∞

```
rep(i, 0, 30) if (d >= rom[i]) d -= rom[i], r += smb[i]; return r;
                3000, 2000, 1000, 900, 800, 700, 600, 500, 400, 300, 200, 100,
                                                                                      90, 80, 70, 60, 50, 40, 30, 20, 10
                                                                                                                                                                                                string toRoman(11 d) {
const int rom[30] = {
                                                    9,8,7,6,5,4,3,2,1
                                                                                                                                                                                                                  string r;
```

friend T operator / (const T &n, const ExactD &d) { return n * d.i; }

bool divide(const T &n) const { return n * i <= t; }

using FastDiv64 = FastD<uint64, uint128>

ExactDiv64 = ExactDcuint64> ExactDiv32 = ExactDruint32

using using

using FastDiv32 = FastD<uint32, uint64>;

return !e ? x : mul_inv(n, e - 1, x * (2 - x * n)); constexpr static T mul_inv(T n, int e = 6, T $\times = 1$) {

ExactD(const T &n): t(T(-1) / n), i(mul_inv(n)) {}

ExactD() = default;

template<class T> // 只能用于奇数

struct ExactD {

8.9 Strtok

```
char s[111]; gets(s); vector<string> a;
for(char* p=strtok(s," .,()");p;p=strtok(NULL," .,()")) a.pb(p);
```

int ne[N][M] , fail[N] , fa[N] , rt , L;
void ini(){ fill_n(ne[fail[0] = N-1],M,0);L = 0;rt = newnode();}

int newnode(){ fill_n(ne[L],M,0); return L++; }

void add(char *s){

int p = rt;

if([ne[p][c]) ne[p][c] = newnode() , fa[L-1] = p;

p = ne[p][c]

int c = s[i] - 'a'; // modify

for(int i=0;s[i];++i){

8.10 Time

```
clock_t st = clock(); CLOCKS_PER_SEC;
```

8.11 duipai

```
#!/bin/bash
while true; do
./gen > gen.in
./sol <gen.in >sol.out
./dp <gen.in >dp.out
if diff sol.out dp.out; then
printf "AC\n"
else
printf "wa\n"
exit 0
fi
done
// sh duipai.sh
```

8.12 回溯时还原标记

```
pair<int*, int> sta[N * 5]; int top;
void add(int &a) { sta[++top] = mp(&a, a); }
void dfs(int u) {
   int ttop = top;
   add(var); modify var;

   // .. dfs

while(top > ttop) *sta[top].fi = sta[top].se, —top;
}
```

9 String

9.1 ACAutomaton

// rank[0~n-1]: 以 i 开头的后缀排名 rank[i]

9.2 DoublingArray

v.pb(ne[c][i]), fail[ne[c][i]] = ne[fail[c]][i]

ne[c][i] = ne[fail[c]][i];

rep(i,0,M) ne[c][i] ?

int c = v[i]

rep(i,0,sz(v)){

 $vi \ v; v.pb(rt)$

void Build(){

```
 \begin{array}{lll} & \text{for(int } i = 1, i < = n, ++1) & \text{rk}[sa[i]] & = i, \\ & \text{for(int } i = 0, i < n, h[rk[i++1]] & \text{k) } & \text{for(k\&} - k, j = sa[rk[i] - 1]; s[i+k] == s[j+k]; ++k), \\ \end{array} 
                                                                                                                                                                                                                                                                                                                                                                                                                        bool cmp(int *x,int a,int b,int d){ return x[a] == x[b] && x[a+d] == x[b+d]; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             rep(i,1,n) \times [sa[i]] = cmp(y, sa[i], sa[i-1], j)?p-1:p++;
                                                                 // sa[0~n]: 排名第的后缀是以i sa[i] 开头
// h[1~n]:S[sa[i-1]] 与 S[sa[i]] 的最长公共前缀长度为 h[i]
int t[N] , wa[N] , wb[N] , sa[N] , h[N];
void sort(int *x,int *y,int n,int m){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      p = 0; rep(i, n-j, n) y[p++] = i;
rep(i,0,n) if(sa[i] >= j) y[p++] = sa[i] - j;
                                                                                                                                                                                                                                                                                                        rep(i,1,m) t[i] += t[i-1];
per(i,0,n) sa[—t[x[y[i]]]] = y[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i,0,n) \times [i] = s[i], y[i] = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             swap(x , y); p = 1; x[sa[0]] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  sort(x , y , n , m);
for(int j=1,p=1;p<n;m=p,j<<=1){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 void cal_h(int *s,int n,int *rk){
namespace Doubling{
   static const int N = 101010;
                                                                                                                                                                                                                                                                                                                                                                                                                                                         void da(int *s,int n,int m){
                                                                                                                                                                                                                                                                    rep(i,0,n) t[x[y[i]]]++;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      sort(x , y , n , m);
                                                                                                                                                                                                                              rep(i,0,m) t[i] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        int *x=wa, *y=wb;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int j, k=0;
```

// 生成字符集为 m , 长度不超过 n 的所有 lyndon word , 字符集从 a 开始

void lyndon_generate(int n, int m) {

for (int i = 1, x = 1; ; ++i) {

æ

a b

p 7-1

t: a nt:-1 s: a

 Kmp

9.4

char z = |a' + m - 1, s[1000]; s[0] = |a' - 1;

```
while(j >= 0 && s[i] != t[j + 1]) j = nt[j];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                            // O(n) 分解为字典序非严格降的 1yndon word 分解唯
                                           void kmp(char *s,int *ns,char *t,int *nt){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int n = strlen(s) + 1; // zero used here
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if (++cur == mid) cur = start;
                                                                                                                                                                                                                          if(j + 1 == lent) j = nt[j]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      int start = 0, mid = 1, cur = 0;
                                                                                                                                                                             if(s[i] == t[j + \bar{1}] ++j;
                                                                                                                              for(int i=0, j=-1;i<lens; ++i){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  while (start + temp <= i){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   For (int i = 0; i < n; ++i){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   else if (s[i] < s[cur]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   } else if (s[i] > s[cur]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             ret.push_back(start);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int temp = mid - start;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      vector<int> duval(char s[]){
                                                                 int lens = strlen(s);
                                                                                        int lent = strlen(t)
                                                                                                                                                                                                                                                                                                                                                                                                                               LyndonWord
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if (s[i] == s[cur]){
                                                                                                                                                                                                                                                                                                                                          kmp(t+1,nt+1,t,nt)
                                                                                                                                                                                                                                                                                        void KMP(){
    scanf("%s%s", s, t);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        i = cur = start;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          start += temp;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                mid = start + 1;
 7
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            ret.push_back(0);
                                                                                                                                                                                                                                                                                                                                                             kmp(s,ns,t,nt);
                                                                                                                                                                                                   ns[i] = j;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           mid = i + 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              vector<int> ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                cur = start;
                                                                                                             nt[0] = -1;
 7
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return ret;
 ď
 ns: 0 1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       0126
                                                                                                                                                                                                                                                                                                                                                                                                                               9.5
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    cbaabc
                                                                                                                                                                                                                        for(int i=1;i<=lim;++i) p[j][i] = min(p[j-1][i] , p[j-1][i+(1<<j>>1)]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       for(int i=0,x=0,y=0;i<lens;++i){
    z[i] = i <= y ? min(y-i,p[i-x]) : 0;
    while(i + z[i] < lens && z[i] < lent && s[i + z[i]] == t[z[i]]) ++z[i];
    if(y <= i + z[i]) x = i, y = i + z[i];</pre>
                                                                                                             Doubling::cal_h(in,n,rk); 
 Log[0] = -1; for(int i=1;i<=n;++i) Log[i] = Log[i-1] + (i==(i&(-i)));
                                                                                                                                                      for(int i=1;i<=n;++i) p[0][i] = Doubling::h[i]</pre>
                                           int p[18][N] , rk[N] , in[N] , Log[N] , n;
void Build(){
                                                                                                                                                                                                                                                                                                                                                                                                        return min(p[t][a] , p[t][b-(1<<t)+1]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  void exkmp(char *s,int *z,char *t,int *p){
struct DA\{ // [\theta, n] , in[n] = \theta , n \ load static const int N = 101010;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             s 串的每个后缀与 t 串的最长公共前缀
                                                                                                                                                                                                                                                                                                                                       a = rk[a] , b = rk[b];
if(a > b) swap(a , b);++a;
                                                                                      Doubling::da(in,n+1,300),
                                                                                                                                                                             for(int j=1,1<<j<=n,++j)
                                                                                                                                                                                                       int \lim = n+1-(1 << j);
                                                                                                                                                                                                                                                                                           // 某两个后缀的最长公共前缀
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     В
                                                                                                                                                                                                                                                                                                                                                                                  int t = Log[b-a+1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int lens = strlen(s);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           int lent = strlen(t);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 exkmp(t+1,nt+1,t,nt);
                                                                                                                                                                                                                                                                                                                  int lcp(int a, int b){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         scanf("%s%s", s, t);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    exkmp(s,ns,t,nt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     a w
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    Exkmp
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          В
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   void Exkmp(){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        q
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     p[0]=0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     * t: a
* nt: 0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     * ns: 3
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              * s: a
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    9.3
```

```
int s[N], len[N], ne[N][M], fail[N], cnt[N][K], dep[N], id[N], no[N], last, n, p, cs;
inline int newnode(int l) {
                                                                                                     inline void build() { per(i, 0, p) cnt[fail[i]] += cnt[i]; }
                                                                                                                                                                                                                                           const int K = 11, N = ::N * K, M = 26;
dep[now] = dep[fail[now]] + 1;
                                      last = ne[cur][c], cnt[last]++;
id[n] = last, no[last] = n;
                                                                                                                                                                       _multi
                                                                                                                                                                      PAM
                                                                                                                                                                                                                         Struct PAM {
                                                                                                                                                                       9.8
                                     if (strlen(s)==1 && s[0]=='a'+m-1) return;
for (int j = x; j < n; ++j) s[j] = s[j - x];</pre>
                                                                                for (x = n; s[x - 1] == z; --x);
S[X - 1]++; S[X] = 0;
                                                                                                       ab
abb
```

9.6 Manacher

$9.7 ext{PAM}$

```
return p++; } inline void init() { newnode(p = 0), newnode(s[0] = -1), fail[last = n = 0] = 1; }
                                                                                         int s[N], len[N], ne[N][M], fail[N], cnt[N], dep[N], id[N], no[N], last, n, p;
inline int newnode(int l) { fill_n(ne[p], M, 0); cnt[p] = dep[p] = 0; len[p] = 1;
                                                                                                                                                                                                                                                                       while(s[n - len[x] - 1] != s[n]) x = fail[x]
// [0,p) , 0(even) and 1(odd) is virtual , init!!
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 fail[now] = ne[getfail(fail[cur])][c];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int now = newnode(len[cur] + 2);
                                                                 static const int N = ::N, M = 26;
                                                                                                                                                                                                                                          inline int getfail(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                       int cur = getfail(last);
                                                                                                                                                                                                                                                                                                                                                                     inline void add(int c) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   ne[cur][c] = now;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if(!ne[cur][c]) {
                                                                                                                                                                                                                                                                                                                                                                                                                s[++u] = c;
                                                                                                                                                                                                                                                                                                              return ×;
                            struct PAM {
```

inline void init() { newnode(p = 0), newnode(s[0] = -1), fail[last = n = 0] = 1; cs inline void build() { per(i, 0, p) rep(j, 0, cs) cnt[fail[i]][j] += cnt[i][j]; } **while**(s[n - len[x] - 1] != s[n]) x = fail[x]; $if(c < 0) \{ s[++n] = c; last = 1; return; \}$ int now = newnode(len[cur] + 2); fail[now] = ne[getfail(fail[cur])][c]; last = ne[cur][c], cnt[last][cs]++; ne[cur][c] = now; dep[now] = dep[fail[now]] + 1; id[n] = last, no[last] = n;for(all char) add(char); inline int getfail(int x) { int cur = getfail(last); dep[p] = 0; len[p] = 1;++cs; add(-cs-1); fill_n(ne[p], M, 0); fill_n(cnt[p], K, 0); inline void add(int c) { if(!ne[cur][c]) { for(all string) { inline void ins() { return p++; s[++u] = c;return x;

9.9 SAIS

```
/*
* Ensure that str[n] is the unique lexicographically smallest character in str.
* time complexity: O(n)
*/
namespace SA {
```

```
if(ne[p][c] \& l[ne[p][c]] == l[p] + 1) { last = ne[p][c]; return ; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int R[N], RF[N], tmp[N], pos[N], tax[N], tp[N], sa[N], siz, n, pa[N][M];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       par[q] = par[np] = nq;
while(p && ne[p][c] == q) ne[p][c] = nq, p = par[p];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 while(p && !ne[p][c]) ne[p][c] = np, p = par[p];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              O(nlogn)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int h(int c) { return c - 'a' + 1; }
void Qsort(int *sa, int *R, int *tp, int siz)
                                                                                                                                   int par[N], 1[N], ne[N][M], rt, last, L;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           copy(ne[q], ne[q] + M, ne[nq]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          :b
=
                                                                                                 static const int N = ::N << 1, M = 26;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         // trie 树点带字母,每个点到根的字符串排序,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         // C 为字符集大小, 从 a 开始, M 为倍增深度
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 1, L + 1) cnt[i] += cnt[i - 1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              rep(i, 1, L + 1) cur[cnt[1[i]] = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if(1[q] == 1[p] + 1) par[np]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    fill(ne[rt], ne[rt] + M, 0);
                                                                                                                                                                                                                                                                                                                                                                                ·
()
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             const int N = 5e5, M = 21, C = 26;
                                                                                                                                                                                                                                                                                                                                                                          fill(ne[np], ne[np] + M,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        1[nq] = 1[p] + 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 1, L + 1) ++cnt[l[i]];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             par[nq] = par[q]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        int q = ne[p][c];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if(!p) par[np] = rt;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           int ng = ++L;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        // 调用 Init 之后, 取 sa[]
* [1[par[s]] + 1, 1[s]]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int n, fa[N]; char s[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rt = last = L = 1;
                                                                                                                                                                                                                                                                                                                                                                                                       1[np] = 1[p] + 1;
                                                                                                                                                                   void add(int c) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                SA trie
                                                                                                                                                                                                                                                                                                                                             int np = ++L;
                                                                                                                                                                                                             int p = last;
                                                                                                                                                                                                                                                                                                                                                                                                                                          last = np;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         1[0] = -1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               void ini() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         else {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            // BucketSort
                                                                 struct SAM {
                                                                                                                                                                                                                                            /* ex
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 struct SA {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        else 
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  9.11
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           for (int i = n - 2; \sim i; i = n) t[i] = s[i] = s[i + 1]? t[i + 1] : s[i] > s[i + 1]; for (int i = 1; i < n; i + i) rk[i] = t[i - 1] && !t[i] ? (p[n1] = i, n1 + i) : -1;
                                                                                                                                                                                                                                                                                                         for (int i = 1; i < m; i++) cur[i] = cnt[i-1];
for (int i = 0; i < n; i++) if (sa[i] > 0 && t[sa[i]-1]) pushL(sa[i]-1); \
for (int i = 0; i < m; i++) cur[i] = cnt[i]-1; \
\]</pre>
                                                                                                                                                                                                                                                                                                                                                                                                       for (int i = n-1; \sim i; i-) if (sa[i] > 0 && it[sa[i]-1]) pushS(sa[i]-1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if (ch < 1 || p[x + 1] - p[x] != p[y + 1] - p[y]) ch++;
else for (int j = p[x], k = p[y]; j <= p[x + 1]; j++, k++)
if ((s[j] << 1 | t[j]) != (s[k] << 1 | t[k])) { ch++; break; }</pre>
                                  int sa[N], rk[N], ht[N], s[N << 1], t[N << 1], p[N], cnt[N], cur[N];</pre>
                                                                                                                                   #define inducedSort(v) std::fill_n(sa, n, -1); std::fill_n(cnt, m, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   while (i + h < n && j + h < n && s[i + h] == s[j + h]) h++;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  for (int i = 0, x, y; i < n; i++) if (\sim(x = rk[sa[i]])) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if (ch + 1 < n1) sais(n1, ch + 1, s1, t + n, p + n1);
else for (int i = 0; i < n1; i++) sa[s1[i]] = i;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int n1 = t[n - 1] = 0, ch = rk[0] = -1, *s1 = s + n;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       for (int i = 0; i < n; i++) s[i] = rk[str[i]] - 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            sais(n, m, s, t, p); for (int i = 0; i < n; i++) rk[sa[i]] = i; for (int i = 0, h = ht[0] = 0; i < n - 1; i++) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     for (int i = 0; i < m; i++) rk[i + 1] += rk[i];</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                            void sais(int n, int m, int *s, int *t, int *p) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for (int i = 0; i < n1; i++) s1[i] = p[sa[i]];
                                                                                                                                                                   for (int i = 0; i < n; i++) cnt[s[i]]++;
for (int i = 1; i < m; i++) cnt[i] += cnt[i-1];
for (int i = 0; i < m; i++) cur[i] = cnt[i]-1;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 std::fill_n(rk, m + 1, 0);
for (int i = 0; i < n; i++) rk[str[i]] = 1;</pre>
                                                                                                                                                                                                                                                                      for (int i = n1-1; \sim i; i...) pushS(v[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             void suffixArray(int n, const T *str) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int mapCharToInt(int n, const T *str) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    int m = *max_element(str, str + n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int m = mapCharToInt(++n, str);
                                                                    #define pushS(x) sa[cur[s[x]]—] = x #define pushL(x) sa[cur[s[x]]++] = x
  const static int N = 1000000 + 10
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if (ht[rk[i]] = h) h
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   int j = sa[rk[i] - 1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             s1[y = x] = ch;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  template<typename T>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                template<typename T>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   inducedSort(s1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        inducedSort(p);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               return rk[m];
```

rep(i, 1, siz + 1) tax[i] += tax[i - 1]; per(i, 1, n + 1) sa[tax[R[tp[i]]]—] = tp[i];

* [0,L] , 0 is virtual , 1 is rt , init!!

 \mathbf{SAM}

9.10

rep(i, 1, n + 1) tax[R[tp[i]]]++;

rep(i, 0, siz + 1) tax[i] = 0;

```
len
                                                           inline Int operator * (const Int &c) const { return Int(mul(a, c.a), mul(b, c.b)); }
inline Int operator - (const Int \&C) const { return Int(upd(a, -C.a), upd(b, -C.b));
                                                                                                                                                                                                                                                                                                                                                                                                                    inline Str operator + (const Str &c) const { return Str(a * B[c.len] + c.a, len +
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               inline Str operator - (const Str &c) const \{ return Str(a-c.a * B[len-c.len],
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                inline bool operator == (const tr \&c) const tr \&c return a == c.a x \& te = c.len;}
                                                                                        inline bool operator == (const Int &c) const {return a == c.a && b == c.b;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           void init(vi &s, Str *ha) {
    rep(i, 0, sz(s)) ha[i] = i > 0 ? ha[i-1] + Str(s[i] + 1) : Str(s[0] + 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       if(nxt1[x][i]+nxt2[y][i]<n+1) f[x][y]++;
f[x][y]=(f[x][y]+bfs(nxt1[x][i],nxt2[y][i]))%mod;
                                                                                                                                                                                                                                                                                                                                                    Str(Int a = _0, int len = 0) : a(a), len(len) {}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if(f[x][y]) return f[x][y];
for(LL i=1;i<=a;++i) if(nxt1[x][i]&&nxt2[y][i]){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   for(LL j=1;j<=a;++j) nxt[i-1][j]=nxt[i][j];</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if(nxt1[x][i]+nxt2[y][i]>n+1) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         return 1 > 0? ha[r] - ha[1-1] : ha[r];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                f[x][y]+=Dfs(nxt1[x][i],nxt2[y][i]);
                                                                                                                                                                                                                      rep(i, 2, n+1) B[i] = B[i-1] * B[1];
                                                                                                                                                                                                                                                                                                                                                                                  Str(int \times) \{a = Int(x, \times); len = 1;\}
                                                                                                                                                                                         B[0] = _1; B[1] = Int(233, 241);
                                                                                                                           0 = Int(), 1 = Int(1, 1), B[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           Str sub(Str *ha, int 1, int r)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                LL Dfs(LL x, LL y){
   if(f[x][y]) return f[x][y];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if (1 > r) return Str();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       * include empty string
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   求两串的公共子序列个数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    序列自动机
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       for(LL i=n; i>=1;---i){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            * n is string lenth
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     nxt[i-1][s[i]]=i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 return ++f[x][y];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         // 求回文子序列个数
LL Dfs(LL x,LL y){
                                                                                                                                                                                                                                                                                                                    Int a; int len;
                                                                                                                                                           void init(int n){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                               // 减去一个前缀
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              * a is char size
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  ha[N], hb[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     - c.len); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            * O is root
                                                                                                                                                                                                                                                                                 struct Str{
                                                                                                                                                                                                                                                                                                                                                                                                                                                       len); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     // 构建
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         9.14
                                                                                                                                                                                                                                                                                                                    Qsort(tp, RF, sa, n);
Qsort(sa, R, tp, R[sa[n]]);
rep(i, 1, n + 1) tmp[i] = R[i]; R[sa[1]] = 1;
rep(i, 2, n + 1) R[sa[i]] =
   (tmp[sa[i]] == tmp[sa[i - 1]] && tmp[pa[sa[i]][p]] == tmp[pa[sa[i - 1]][p]])
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     Int(int a = 0, int b = 0) : a(a), b(b) {}
inline Int operator + (const Int &c) const { return Int(upd(a, c.a), upd(b, c.b)); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      h[0] = s[0] + 1; rep(i, 1, sz(s)) h[i] = upd(mul(h[i - 1], ba), s[i] + 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          Str(int\ ba) : ba(ba) { B[0] = 1; rep(i, 1, N) B[i] = mul(B[i-1], ba); }
                                                                                                                                                        rep(i, 2, n + 1) rep(j, 1, M) pa[i][j] = pa[pa[i][j - 1]][j - 1]; rep(i, 1, n + 1) R[i] = h(s[i]), tp[i] = i;
                                                                                                                           n = n, pa[1][0] = 0; rep(i, 2, n + 1) pa[i][0] = fa[i];
                                                                                                                                                                                                                      Qsort(sa, R, tp, C); rep(i, 1, n + 1) pos[sa[i]] = i; for (int w = 1, p = 0; w < n; w <<= 1, p++) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            inline int mul(int a, int b) {return 111 * a * b % P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               return upd(h[r], \negmul(h[l - 1], B[r - l + 1]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        int mul(int a, int b) { return 111 * a * b % P; }
                                                                                                                                                                                                                                                                                    rep(i, 1, n + 1) RF[i] = pos[pa[i][p]];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               R[sa[i-1]] : R[sa[i-1]] + 1;
                                                                                           void Init(int _n, int fa[], char s[]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(i, 1, n + 1) pos[sa[i]] = i;
                                                             // fa[] 表示树上父节点编号, 根为 1
                           // s[] 表示字母点权,下标从 1 开始
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 const int P = 1e9 + 7, N = 101010;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if((a += b) >= P) a -= P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          return a < 0 ? a + P : a;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              inline int upd(int a, int b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  StrHash 双哈希
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if((a += b) >= P) a -= P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            return a < 0 ? a + P : a;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int upd(int a, int b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int sub(int l, int r) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if(!1) return h[r];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        struct Str {
   int B[N], h[N], ba;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                const int P = 1e9 + 7;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    }ha1(233), ha2(241);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           void init(vi &s)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     StrHash
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               inta, b;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            struct Int{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      9.13
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     9.12
```

```
dfs(1,0,g);
solve(1,0,false,g); // 如果输入是单组数据,改成 true 可以优化常数
                                                                                                                  HeavyChain
                                                                                                                                                                   // id starts with
                                                                                                                                                                                           struct HeavyChain{
                                                                                                                  10.2
                                                                // 求一个 A , B 的最长公共子序列 S , 使得 C 是 S 的子序列
                                                                                                                                   for(LL j=1;j<=a;++j) nxt[i][j]=i;
                                                                                       for(LL i=1;i<=a;++i) nxt[n][i]=n;</pre>
                                                                                                                                                         nxt[i][c[i+1]]=i+1;
                                                                                                           for(LL i=0;i<n;++i){</pre>
                    return ++f[x][y];
```

9.15 最小表示法

```
// 下标从 Ø 开始
// s[] 开两倍长度
int MIN(char s[,int L){
    rep(i,0,L) s[L+i]=s[i]; s[2*L]=0;
    int i=0, j=1;
    while(i<l && j<l){
        int k=0;
        while(s[i+k]==s[j+k] && k<L)++k;
    if(k==L)return min(i,j);
        // 最大改成 <
        if(s[i+k]>s[j+k]);
        else j=max(j+k+1,j+1);
    }
    return min(i,j);
}
```

10 Tree

10.1 DsuOnTree

```
// id starts with 1

namespace QuerySubtree{
    static const int N = ::N;
    int sz[N] , wson[N] , par[N];
    void dfs(int c,int fa,vi g[]){
        sz[c]=1;par[c]=fa;int &s=wson[c]=0;
        for(auto t:g[c]) if(t!=fa) dfs(t,c,g),sz[c]+=sz[t],(sz[t]>=sz[s])&&(s=t);
    }

    void solve(int c,int fa,bool iswson,vi g[]){
        for(auto t:g[c]) if(t!=wson[c] && t!= fa) solve(t, c, false, g);
        if(wson[c]) solve(wson[c] , c, true, g);
        for(auto t:g[c]) if(t!=wson[c] && t!= fa) {
            // #\sqrt{shfhfe} \text{hhfhfe} \text{m} \text{// if t!=wson[c] && t!= fa) }

        // #\sqrt{shfhfe} \text{hhfhfe} \text{hhfhfe} \text{// mRk2qPhfhfe} \text{hhfhfe} \text{// mRk2qPhfhfe} \text{hhfhfe} \text{// way solve(vi g[])} \text{// woid solve(vi g[])} \text{// woid solve(vi g[])} \text{// void solve(vi g[])} \text{// solve
```

```
int sz[N], wson[N], top[N], dep[N], id[N], _, par[N], who[N]; void dfs(int c, int fa, vi g[]){
                                                                                                                                                                                                                                                                                                                                                                                                                                    if(s) top[s] = top[c], dfs2(s, c, g);

for(auto t : g[c]) if(t != fa && t != s) dfs2(t, c, g);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int fa = top[a], fb = top[b];
while(fa != fb){
  if(dep[fa] < dep[fb]) swap(a, b), swap(fa, fb);</pre>
                                                                                         par[c] = fa;
dep[c] = dep[fa] + 1;
int &s = wson[c] = top[c] = 0;
for(auto t : g[c]) if(t != fa)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if(dep[a] < dep[b]) swap(a, b);
// Cal id[b] .. id[a]</pre>
                                                                                                                                                                                                                                                                                                                 void dfs2(int c, int fa, vi g[]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  a = par[fa]; fa = top[a];
                                                                                                                                                                                                                                          if(sz[t] >= sz[s]) s =
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        // cal id[fa] .. id[a]
                                                                                                                                                                                                                                                                                                                                                                                                              if(!top[c]) top[c] = c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            void Query(int a, int b){
static const int N = ::N;
                                                                                                                                                                                             dfs(t, c, g);
sz[c] += sz[t];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           void Build(vi g[]){
                                                                                                                                                                                                                                                                                                                                                                                         int s = wson[c];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      dfs2(1, 0, g);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       dfs(1, 0, g);
                                                                                                                                                                                                                                                                                                                                           id[c] = ++_{-};
                                                                                                                                                                                                                                                                                                                                                               who[\_] = c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  // b is lca
                                                                      sz[c] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        }hc;
```

10.3 LCARMQ

```
// N is 2 size of tree , id of nodes start from 1
struct LCARMQ{
    static const int N = 101010 << 1;
    int a[20][N] , lft[N] , dep[N] , lg[N] , L;</pre>
```

```
// 注意统计以 c 为起点的链的答案,注意深度的限制(两棵子树都要注意
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  r 所在块,
                                                                                                                                                                                                                                                                                        else return rwho[id[top[p0]]+j1-del];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              // 带修改莫队: 块大小 M(2/3) 按照 1 所在块,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       const int N = ::N, SZ = Sqrt(N), M = 17;
                                                                                                                                                                                                                                                            if(del>=j1) return who[id[p0]-j1];
                                                                                                                                            int j0=1<<1g[k];
int p0=jump[x][lg[k]];
int j1=k-j0;
int del=id[p0]-id[top[p0]];</pre>
                                                                                                                                                                                                                                                                                                                                                                                                        10.5 MoOnTree Path
                                                                                       int kth_par(int x,int k){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      int cd; // starts from 1
                                                             // kth_par should exist
                                                                                                                    if(k==0) return x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               namespace MoOnTree {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                      // 不带修改莫队
                                                                                                                                                                                                                                                                                                                                                 }hc;
                                                                                                                                                                                                                                                                                                                   rep(j,0,lim) a[i][j] = rmin(a[i-1][j] , a[i-1][j+(1<<i>1)]);
                                                                                                                  for(auto t : g[c]) if(t!=fa) dep[t]=dep[c]+1, dfs(t,c,g), add(c);
    int rmin(int x, int y){return dep[x] < dep[y] ? x : y;} void add(int x){ a[0][L++] = x;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        return rmin(a[i][x] , a[i][y+1-(1<<i)]);</pre>
                                                           void dfs(int c,int fa,const vi g[]){
                                                                                                                                                                                                       L = 0; dfs(1, 0, g); dep[0] = -1;
                                                                                                                                                                                                                    rep(i,2,L) lg[i]=lg[i>>1]+1;
rep(i,1,20){
                                                                                                                                                                                                                                                                                           int lim = L+1-(1<<i);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                   x = lft[x], y = lft[y];

if(x > y) swap(x, y);
                                                                                                                                                                        void Build(const vi g[]){
                                                                                                                                                                                                                                                                                                                                                                                                        int lca(int x,int y){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int i = lg[y-x+1]
                                                                                         lft[c]=L;add(c);
```

10.4 LongChain

```
dfs(t,c,g),dep[c]=max(dep[t]+1,dep[c]),(dep[t]>=dep[s])&&(s=t);
                                                                                                                                                                          for(auto t : g[c]) if(t != fa && t != wson[c]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                       for(auto t:g[c]) if(t!=fa&&t!=s) dfs2(t,c,t,g);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      void solve(int c, int fa, vi g[]) {
  for(auto t : g[c]) if(t != fa) solve(t, c, g);
  if(wson[c]) {
                                                     int wson[N] , top[N] , dep[N] , lg[N];
int jump[N][20] , id[N] , who[N] , rwho[N] , _;
void dfs(int c,int fa,vi g[]){
                                                                                                                                                                                                                                                                                                                                                                                                                      if(s) top[s]=top[c],dfs2(s,c,jump[rc][0],g);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  // upd c by wson[c], O(1) or O(log(n))
                                                                                                                                                                                                                                                                                                 void dfs2(int c,int fa,int rc,vi g[]){
                                                                                                                                                dep[c]=1;int \&s=wson[c]=top[c]=0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                dfs(1,0,g);\_=0;dfs2(1,0,1,g);\\ rep(i,2,N) lg[i]=lg[i>>1]+1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       // brute force upd c by t
                                                                                                                                                                                                                                                                                                                                                                 who[id[c]=++_]=c;rwho[_]=rc;
                                                                                                                                                                                                           for(auto t:g[c]) if(t!=fa)
                                                                                                                                                                                                                                                                                                                                if(!top[c]) top[c]=c,rc=c;
                         static const int N = ::N,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             void Build(vi g[]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          // c is leaf
                                                                                                                                                                                                                                                                                                                                                                                                 int s=wson[c]
struct LongChain{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  } else {
```

```
struct Node {
   int l, r, id, lca;
   Node(int id, int l, int r, int lca = 0) : id(id), l(l), r(r), lca(lca) {}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    int lca(int x, int y) {
   if(dep[x] > dep[y]) swap(x, y);
   per(i, 0, M) if(dep[pre[y][i]] >= dep[x]) y = pre[y][i];
   per(i, 0, M) if(pre[x][i] != pre[y][i]) x = pre[x][i], y = pre[y][i];
                                                                                                     int dep[N], pre[N][M], st[N], ed[N], dfn[N << 1], B[N << 1], cnt[N];</pre>
time 排序
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if(f == u) \{ nds.pb(Node(id, st[u], st[v]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(B[1] != B[c.1]) return B[1] < B[c.1];
                                                                                                                                                                                                                 bool operator < (const Node &c) const
                                                                                                                                                                                                                                                                          return (r < c.r) \wedge (B[1] \& 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if(st[u] > st[v]) swap(u, v);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              nds.pb(Node(id, l, r, f));
                                                                                                                                                                                                                                                                                                                                                                                   void dfs(int u, int fa, vi g[])
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                void adde(int u, int v, int id)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              } else {
   int 1 = ed[u], r = st[v];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      dfn[++cd] = u, ed[u] = cd;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if(1 > r) swap(1, r);
                                                                                                                                                                                                                                                                                                                                                                                                          dep[u] = dep[fa] + 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if(x == y) return x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int f = lca(u, v);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               return pre[x][0];
                                                                                                                                                                                                                                                                                                                                                                                                                                      pre[u][0] = fa;
                                                                                                                                                                                                                                                                                                                                                        vector<Node> nds;
```

```
for(auto t : g[c]) if(!vis[t]&&t!=fa) dfssz(t,c,Sz,rt) , sz[c]+=sz[t];
                                                                                                                                                                                                   \textbf{for}(\textbf{auto} \ t \ : \ g[c]) \ \textbf{if}(!vis[t] \& kt! = fa) \ dfssz(t,c,Sz,rt) \ , \ sz[c] + = sz[t];
                                                                                                                                                                                                                                                                  int dfs(int c){
   int rt=0;dfssz(c,0,0,rt);dfssz(c,0,sz[c],rt=0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                int rt=0;dfssz(c,0,0,rt);dfssz(c,0,sz[c],rt=0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  * 注意计算以 rt 为起点的路径、只包含 rt 的路径
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           bool vis[N]; int sz[N], par[N]; vi G[N];
void dfssz(int c,int fa,int Sz,int &rt){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 bool vis[N]; int sz[N];
void dfssz(int c,int fa,int Sz,int &rt){
                                                                                                                                                                                                                                                                                                                                          for(auto v : g[rt]) if(!vis[v]) {
  int t = dfs(v);
                                                                                                                                                                                                                          if(!rt && sz[c]*2>Sz) rt=c,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if(!rt && sz[c]*2>Sz) rt=c,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                fill_n(G + 1, n, vi());
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        fill_n(par + 1, n, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               vis[rt] = true;
                                                                                                                                                                                                                                                                                                                                                                                           G[rt].pb(t);
                                                                                                                                                                                                                                                                                                                                                                                                               par[t] = rt;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         vis[rt] = true;
                                                                                                     const int N = ::N;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             const int N = ::N
                                                                                   namespace Centriod {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    namespace Centriod {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      void dfs(int c){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                // id starts from 1
                                                       // id starts from
点分核
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                sz[c] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       边分树
                                                                                                                                                                           sz[c] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    点分治
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     void init() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                               return rt;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      namespace ET {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 // init
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        10.8
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         10.9
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       rep(i, 1, sz(v)){
  int lca = R.lca(tp[_-1] , v[i]);
  cntl = 0; while(_ > 0 && R.dep[lca] < R.dep[tp[_-1]]) l[++cntl] = tp[___];
  if(_ == 0 || lca != tp[_-1]) del[++cntd] = tp[_++] = lca;
  l[++cntl] = tp[_-1]; del[++cntd] = tp[_++] = v[i];
  rep(i, 2, cntl + 1) {
  int u = l[i], v = l[i - 1];
</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 _{-} = cntd = 0; del[++cntd] = tp[_++] = v[0];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int tp[N], _, del[N], cntd, l[N], cntl;
void solve(vi&v,LCARMQ&R){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if(nd.lca) upd(st[nd.lca], -1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if(nd.lca) upd(st[nd.lca], 1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          per(i, 0, _ - 1) {
   int u = tp[i], v = tp[i + 1];
                                                                                                                                                                      (cnt[p] == 1)? add(p): sub(p);
                                                                                                                                                                                                                                                                                                                                                                                                                                 while(r > nd.r) upd(r--, -1);
                                                                                                                                                                                                                 void solve(vi g[]) {
    rep(i, 0, N << 1) B[i] = i / SZ
    dfs(1, cd = 0, g);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                      while(1 < nd.1) upd(1++, -1)
                                                                                                                                                                                                                                                                                                                                                                                    while(r < nd.r) upd(++r, 1);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                           while(1 > nd.1) upd(—1, 1);
                                                                                                                                                                                                                                                                                                             sort(all(nds));
int l = 1, r = 0;
for(auto &nd : nds) {
                                                      void add(int p) { }
void sub(int p) { }
void upd(int p, int c) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       rep(i, 1, cntd + 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              const int N = ::N \iff 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         // g[u].pb(v);
                                  // p is index in tree
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           // g[u].pb(v);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       // save ans
                                                                                                                          p = dfn[p];
cnt[p] += c;
                                                                                                                                                                                                                                                                                             // adde(u, v)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         namespace Vtree{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                // del
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   // sort !
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                10.6
```

const int N = ::N << 1;

```
friend Segtree* Insert(Segtree *p, int 1, int r, long long x, long long val, long
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  Segtree *temp = Insert(p->rs, mid+1, r, x, val, pos); return new Segtree(p->ls, temp, min(temp->sum + p->ls->sum, k+1), 0);
                                                                                                                                                                                                                                                                                                                                                                                                                        return new Segtree(temp, p->rs, min(temp->sum + p->rs->sum, k+1), 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 tree[i-1] = Insert(tree[i], 0, mx, a[i], i == n+1?1 : tree[i]->sum, i);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   for(int i = 1; i <= n; i ++) scanf("%d", &a[i]), mx = max(mx, a[i]);</pre>
                                                                                                                                                                                                                                                                                                                                                        Segtree *temp = Insert(p->ls, l, mid, x, val, pos);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        for(int i = 1; i <= top; i ++) printf("%d ", st[i]);</pre>
                                                                                                                                                                                                                                     if(1 == r)return new Segtree(0x0, 0x0, val, pos);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if(k \le p\rightarrow ls\rightarrow sum) return Find(p\rightarrow ls, l, mid);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               tree[n+1]->ls = tree[n+1]->rs = tree[n+1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            friend int Find(Segtree *p, int 1, int r){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(k > tree[0]->sum) return puts("-1"), 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   tree[n+1] = new Segtree(0x0, 0x0, 0, 0)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              return Find(p\rightarrowrs, mid+1, r);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     . (XM
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               for(int i = n+1; i >= 0; i --)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if(1 == r)return p->pos;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       now = Find(tree[now], 0,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               int mid = 1 + r >> 1;
ls(_), rs(__), sum(_
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if(now == n+1)break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   st[++ top] = a[now];
                                                                                                                                                                         int mid = 1 + r >>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              k -= p->1s->sum;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          // 求字典序第 k 小的子序列
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             printf("%d\n", top);
                                                                                                                                                                                                                                                                                                     if(x <= mid){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    cin >> n >> k;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          Segtree *tree[M];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int st[M], top;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int now = 0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                while(true)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int mx = 0;
                                                                                                                           long pos){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int main(){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                else{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      else
                                                                                                                                                                                                                                                                                                                                                                                                                    if(rt == -1 \mid | max(sz[g.to[rt]], Sz - sz[g.to[rt]]) > max(sz[v], Sz - sz[v]))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             \inf_{x \in \mathbb{R}} [x] = (x + 1) + (x + 
                                                                                                                                                                         for(int i = g.hd[u]; \sim i; i = g.ne[i]) if(!vis[i] && g.to[i] != fa)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  for(int i = G.hd[u]; \sim i; i = G.ne[i]) if(G.to[i]! = fa) {
Gra g, T; int L, n, sz[N]; bool vis[N << 1];
                                                           void dfssz(int u, int fa, int Sz, int &rt) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         void init(int n) { fill_n(vis, n << 1, 0); }</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               void rebuild(int u, int fa, const Gra &G) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if(u == 1) L = n = ::n, g.init(n << 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          g.add(pre, G.to[i], G.val[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       g.add(n, G.to[i], G.val[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         g.add(u, G.to[i], G.val[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int I = 0; dfssz(u, 0, 0, I);
if(sz[u] == n) { T.init(n); }
if(sz[u] == 1) return u;
dfssz(u, 0, sz[u], I = -1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           g.add(pre, ++n, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  vis[I] = vis[I^{\Lambda}] = true;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              rebuild(G.to[i], u, G);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 bool F = \vec{0}; int pre = \vec{u};
                                                                                                                                                                                                                                                                                                     dfssz(v, u, Sz, rt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       if(~G.ne[i]) {
                                                                                                                                                                                                                                int v = g.to[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     T._add(_, dfs(ed));
                                                                                                                                                                                                                                                                                                                                                        sz[n] += sz[n];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       pre = n;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        } else {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int dfs(int u)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  } else {
                                                                                                                       sz[u] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    rt = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     return _;
```

11.2 TT 全功能 Claris

return 0;

ZProblems

K 小子序列

11.1

```
int a, b; //ax+b
tag() { a = 1, b = 0; }
tag(int x, int y) { a = x, b = y; }
                        const int inf = \sim 00 >> 1;
 #define N 200010
                                               struct tag {
                                                                                                                       Segtree(Segtree *_, Segtree *_, long long __, long long .
                      int n, a[M]; long long k;
                                                                                               long long sum, pos;
                                                                    Segtree *1s, *rs;
#define M 1001000
                                             struct Segtree{
```

```
else
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if (!isroot(y, t)) { if ((son[f[y]][t] == y) ^ (son[y][t] == x))rotate(x, t);
                                                                                                                                                                  for (int i = 0; i < 2; i++)if (son[x][i])csum[x] = csum[x] + csum[son[x][i]];
                                                                                                                                                                                                                                                                                                                                                                                                                                  if (son[x][w ^ i])f[son[x][w ^ 1]] = y;
if (f[y])for (int z = f[y], i = 0; i < 4; i++)if (son[z][i] == y)son[z][i] = x;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 inline void setson(int x, int t, int y) { son[x][t] = y; f[y] = x; } inline int pos(int x) { for (int i = 0; i < 4; i++)if (son[f[x]][i] == x)return i;
                                                                                                                                                                                                                                                                                                   inline int child(int x, int t) { pb(son[x][t]); return son[x][t]; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   inline void add(int x, int y) { // 从 x 连出一条虚边到 y
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        while (son[x][2] \& in[son[x][2]])x = child(x, 2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            inline void del(int x) { // 将 x 与其虚边上的父亲断开
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     f[x] = f[y]; f[y] = x; son[x][w \land 1] = y; up(y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       for (int i = 2; i < 4; i++)if (!son[x][i])
                                                                                                                                                                                                                                                                                                                                                                      int y = f[x], w = (son[y][t + 1] == x) + son[y][w] = son[x][w ^ 1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int s = 1, i = x, y; a[1] = i;
while (!isroot(i, t))a[++s] = i = f[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 son[x][2] = son[x][3] = 0; in[x] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        inline void splay(int x, int t = 0) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int x = rub ? ru[rub—] : ++tot;
                                                                                                                                                                                                 asum[x] = csum[x] + tsum[x];
                                                                                                                                                                                                                                                                                                                                     inline void rotate(int x, int t)
                                                                                                                                   csum[x] = data(val[x]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              setson(z, 2, son[x][2]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            while (!isroot(x, t)) {
                                 asum[x] = tsum[x];
csum[x] = data();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          while (s)pb(a[s-]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rotate(y, t); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     setson(x, 2, z);
splay(z, 2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                inline int newnode() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         setson(x, i, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               int z = newnode();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if (!f[x])return;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               rotate(x, t);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if (!y)return;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if (!x)return;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             y = f[x];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     return x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 splay(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         return 4; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      (x)qd
                                                                                                    else {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                (x)dn
                                                                                                                                                                                                                                                                                                   inline data operator+(const data&x) { return data(sum + x.sum, min(minv, x.minv), max
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       if (!x)return;
if (rev[x])rev1(son[x][0]), rev1(son[x][1]), rev[x] = 0;
if (!in[x] && ctag[x].ex())tagchain(son[x][0], ctag[x]), tagchain(son[x][1], ctag[x])
                                                                                                                                                                                                                                                                                                                                                                                                        inline data operator+(const data&a, const tag&b) { return a.size ? data(a.sum*b.a + a.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             for (int i = 0; i < 2; i++)if (son[x][i])tsum[x] = tsum[x] + tsum[son[x][i]]; for (int i = 2; i < 4; i++)if (son[x][i])tsum[x] = tsum[x] + asum[son[x][i]]; if (in[x]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       inline bool isroot(int x, int t) {
   if (t) return !f[x] || !in[f[x]] || !in[x];
   return !f[x] || (son[f[x]][0] != x&&son[f[x]][1] != x) || in[f[x]] || in[x];
                                                                                                                                                                                                                                                                    size = d;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                      //son: :0—1 重链儿子, 2—3 : AAA 树儿子
int f[N], son[N][4], a[N], tot, rt, rub, ru[N], val[N]; bool rev[N], in[N];
                                 inline tag operator+(const tag&x) { return tag(a^*x.a, b^*x.a + x.b); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  tagtree(son[x][0], ttag[x], 0), tagtree(son[x][1], ttag[x], 0);
tagtree(son[x][2], ttag[x], 1), tagtree(son[x][3], ttag[x], 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if (!in[x] && t)tagchain(x, p); else asum[x] = csum[x] + tsum[x];
                                                                                                                                                                                                                                                                       maxv = c,
                                                                                                                                                                                                                                                                                                                                                                                                                                    size*b.b, atag(a.minv, b), atag(a.maxv, b), a.size) : a; }
                                                                                                                                                                                                                                data(int x) { sum = minv = maxv = x, size = 1; }
data(int a, int b, int c, int d) { sum = a, minv = b,
                                                                                                                                                                                               data() { sum = size = 0, minv = inf, maxv = -inf; }
                                                                                                  inline int atag(int x, tag y) { return x^*y.a + y.b;
inline bool ex() { return a != 1 || b; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              swap(son[x][0], son[x][1]); rev[x] ^= 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       bool t) {
                                                                                                                                                                                                                                                                                                                                     (maxv, x.maxv), size + x.size); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            inline void tagchain(int x, tag p)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         Ď,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      data csum[N], tsum[N], asum[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 csum[x] = csum[x] + p;
asum[x] = csum[x] + tsum[x];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         tag
                                                                                                                                                                     int sum, minv, maxv, size;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               val[x] = atag(val[x], p),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  inline void tagtree(int x,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        inline void rev1(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 ctag[x] = ctag[x] + p;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  tsum[x] = tsum[x] + p;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              ttag[x] = ttag[x] + p;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      inline void pb(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               inline void up(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         , ctag[x] = tag();
if (ttag[x].ex()) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           ttag[x] = tag();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        tag ctag[N], ttag[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              tsum[x] = data();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if (!x) return;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if (!x) return;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if (!x) return;
                                                                                                                                      struct data {
```

```
splay(x);
val[x] = atag(val[x], p);
for (int i = 2; i < 4; i++) if (son[x][i])tagtree(son[x][i], p, 1);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                data t = data(val[x]);

for (int i = 2; i < 4; i++) if (son[x][i])t = t + asum[son[x][i]];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   for (i = 1; i < n; i++) read(ed[i][0]), read(ed[i][1]);
for (i = 1; i <= n; i++) read(val[i]), up(i);
for (i = 1; i < n; i++) link(ed[i][0], ed[i][1]);</pre>
                                                                                                                                              inline void changechain(int x, int y, tag p) {
                                                                                                                                                                                                                                                                                                                                                                                                   inline void changetree(int x, tag p) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if (lca(x, y) == x)continue;
cut(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if (k == 9) { // x 的父亲变成 y
read(x), read(y);
                                                                                                                                                                                                                                                                       inline data askchain(int x, int y) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int n, m, x, y, z, k, i, ed[N][2];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     inline data asktree(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if (k == 1) { // 换根
inline void cut(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           makeroot(rt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      int main() {
    read(n); read(m);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    link(y, x);
                                                              f[son[x][0]] = 0;
                                                                                                                                                                                                                                                                                                                                                           return csum[y];
                                                                                                                                                                                                                                  tagchain(y, p);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     read(rt);
                                                                                 son[x][0] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          while (m—) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      makeroot(rt);
                                                                                                                                                                   makeroot(x);
                                                                                                                                                                                                                                                                                                 makeroot(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                read(k);
                                                                                                                                                                                          access(y);
splay(y);
                                                                                                                                                                                                                                                                                                                                                                                                                        access(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          access(x);
                         access(x);
                                                                                                                                                                                                                                                                                                                 access(y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             splay(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               splay(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   read(rt);
                                                                                                                                                                                                                                                                                                                                    splay(y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return t;
                                         splay(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   tot = n;
                                                                                                        (x)dn
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          (x)dn
```

```
setson(z, pos(y), child(y, pos(x) ^{\wedge}1)); splay(z, 2);
int y = f[x];
if (in[y]) {
   int s = 1, i = y, z = f[y]; a[1] = i;
   while (!isroot(i, 2))a[++s] = i = f[i];
   while (s)pb(a[s--]);
                                                                                                                                                                                                                                                                                           inline int fa(int x) { // x 通过虚边的父亲
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              splay(x);
while (son[x][0])x = son[x][0];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     inline void link(int x, int y) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                     for (; x; y = x, x = fa(x)) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         inline int lca(int x, int y) {
                                                                                                                                                                                                                                                                                                            splay(x);
if (!f[x])return 0;
if (!in[f[x]])return f[x];
int t = f[x];
splay(t, 2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   inline void makeroot(int x)
                                                                                                                                                                                                                                                                                                                                                                                                                                  inline int access(int x) {
                                                                                                                                                                                                        son[y][pos(x)] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  del(y);
add(x, son[x][1]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           inline int root(int x)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      setson(x, 1, y);
                                                                                                                                                       ru[++rub] = y;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return access(y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       splay(x);
                                                                                                                                                                                                                          splay(y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      makeroot(x);
                                                                                                                                                                                                                                                                                                                                                                                                 return f[t];
                                                                                    if (z) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         add(y, x); access(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                   int y = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              access(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 access(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    access(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           (x) dn
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           return y;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                return x;
                                                                                                                                                                                                                                                           f[x] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   splay(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     rev1(x);
                                                                                                                                                                                         else {
```

```
inline 11 add_mod(11 x, 11 y, 11 mod) { return (x + y) % mod; } inline 11 sub_mod(11 x, 11 y, 11 mod) { return (x - y + mod) % mod; } inline ull mul_add_mod(ull a, ull b, ull c, ull mod) {
                                                                                                                                                                                                                                                                                                                        ^{\prime}/ mod should be not greater than 2^62 (about 4e18)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        T gcd(T a, T b) { return !b ? a : gcd(b, a % b); }
                                                                                                                                                                                                                                                                                                                                                 // return a ^st b ^st mod when mod is less than 2^31
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     return mod128\_64\_small(uill(a) * b + c, mod);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              // ax + by = gcd(a, b), |x| + |y| is minimum void exgcd(11 a, 11 b, 11 &g, 11 &x, 11 &y) {
                                                                                                                                                                                                                            "0"(ull(a)), "1"(ull(a >> 64)), "rm"(b)
                                                                                                                                                                                                                                                                                                                                                                     inline ull mul_mod(ull a, ull b, ull mod) {
                                                                                                            inline ull mod128_64_small(uill a, ull b)
                                                                                                                                                                                                                                                                                                                                                                                                                                                               ull k = (ull)((long double)a * b / mod);
                                                                                                                                                                                                                                                                                                                                                                                                                                        if (mod < int(1e9)) return a * b % mod;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if (n & 1) res = mul_mod(res, a, m);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      // return x, where ax = 1 \pmod{mod}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if (gcd(a, mod) != 1) return -1; 11 b = mod, s = 1, t = 0;
                                          using ull = unsigned long long;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if (!b) \times = 1, y = 0, g = a;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if ((11))res < 0) res += mod;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        exgcd(b, a % b, g, y, x);
y == x * (a / b);
                                                                                                                                                                                                                                                                                                                                                                                              assert(0 <= a && a < mod);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 11 pow_mod(11 a, 11 n, 11 m)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     ull res = a * b - k * mod;
                                                                                                                                                                                                                                                                                                                                                                                                               assert(0 <= b && b < mod),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for (a %= m; n; n >>= 1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        11 mod_inv(11 a, 11 mod) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            a = mul\_mod(a, a, m);
                                                                 using uill = \_uill_t;
                                                                                                                                                                                                        : "=a"(q), "=d"(r)
                       using 11 = 1 long 1 long;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   template<typename T>
#include <algorithm>
                                                                                        // return a % b
                                                                                                                                                              __asm__ (
"divq\t%4"
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        11 res = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       return res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        return res;
                                                                                                                                       ull q, r;
                                                                                                                                                                                                                                                                              return r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     else {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      printf("%d\n", askchain(x, y).minv);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          printf("%d\n", askchain(x, y).maxv);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          printf("%d\n", askchain(x, y).sum);
                                                                                                                                                                                                                                                                          printf("%d\n", asktree(x).minv);
                                                                                                                                                                                                                                                                                                                                                                     printf("%d\n", asktree(x).maxv);
                                                                                                                                                                                                                                                                                                                                                                                                                                                               printf("%d\n", asktree(x).sum);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          changechain(x, y, tag(0, z));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      changechain(x, y, tag(1, z));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     read(x), read(y), read(z);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   read(x), read(y), read(z);
                                                                                                                                                                                   changetree(x, tag(1, y));
                                                                                        changetree(x, tag(0, y));
                                                                                                                                                                                                          }
if (k == 3) { // 子树最小值
                                                                                                                                                                                                                                                                                                   }
if (k == 4) { // 子树最大值
                       }
if (k == 0) { // 子树赋值
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        }
if (k == 7) { // 链最小值
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          (k == 8) { // 链最大值
                                                                                                                                                                                                                                                                                                                                                                                                                 if (k == 11) { // 子树和
                                                                                                               }
if (k == 5) { // 子树加
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       }
if (k == 2) { // 链赋值
----(x) _ r(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            (k == 10) { // 链和
read(x), read(y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      }
if (k == 6) { // 链加
                                                                   read(x), read(y);
                                                                                                                                                              read(x), read(y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     read(x), read(y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      read(x), read(y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               makeroot(rt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   makeroot(rt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   makeroot(rt);
 makeroot(rt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   makeroot(rt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   makeroot(rt);
                                                                                                                                                                                                                                                                                                                                                                                                                                            read(x);
                                                                                                                                                                                                                                                          read(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        ;;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ~ ;
```

11.3 basic

#include <cassert> #pragma once

std::swap(a -= q * b, b);

while (b) { ll q = a / b;

```
s1[0 + j] = (s1[0 + j - min_pe - 1] + (dw)s1[0 + j - min_pe] * i) % pe;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         f_pe[i] = (dw)f_pe[i-1] * fact_range(i-1, p-1) % pe * ifac % pe;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            // f_{p,e}(0..2e-2): 0(e * min(p, e) + e log(p))
ull fac = fact_range(0, p - 1), ifac = mod_inv(fac, pe);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        ret = (ret + (dw)prod * s1[v * min_pe + k]) % pe,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 ull coef = (dw)u \% pe * p \% pe, prod = 1, ret for (ull k = 0; k < min_pe; ++k) {
                                                                                                      // first kind stirling number: O(p * min(p, e))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  cifac[i] = (dw)cifac[i + 1] * cifac[i] % pe;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      // find the value of f_{-}\{p, e\}(x): O(e \log x)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          // product of {up + 1, ..., up + v} mod p^{Ae} auto fact_range = [&] (ull u, ull v) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                for (; m % p == 0; m /= p, ++vs[i]);
                                                                                                                                                                                                                                                                                                                                be'
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          // coprime factorials: O(e + e \log(p))
                                                                                                                                           v1 s1(p * min_pe); s1[0] = 1;

rep(i, 1, p) {

int o = i * min_pe;

s1[o] = (dw)s1[o - min_pe] * i % |
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  for (ull i = 1; i < deg; ++i) {
  ull j = i, v = 0;
  for (; j % p == 0; j /= p, ++v);
  cfac_vs[i] = cfac_vs[i - 1] + v;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     for (int i = deg - 2; i >= 0; —i)
== 2 \&\& e >= 3) period >>= 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               cifac[deg - 1] = mod\_inv(prod, pe);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           ull v = \vec{0}, prod = 1;

for (ull i = 0; i < deg; ++i) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         prod = (dw)prod * coef % pe;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if (x < deg) return f_pe[x];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           vl cifac(deg, 1), cfac_vs(deg);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                prod = (dw)prod * m % pe;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   vl f_pe(deg, 1);
for (ull i = 1; i < deg; ++i)</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        arcd = (dw)prod * j % pe;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   auto evaluate = [\&](ull \times)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  vl vs(deg), inv(deg);
                                                                                                                                                                                                                                                                                                                                                                         rep(j, 1, min_pe)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              ull m = x - i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      inv[i] = prod;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       cifac[i-1] = j;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 v \leftarrow vs[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        ull prod = 1;
if (p
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        } // n! / p^{\Lambda}\{v\_p(n!)\} mod p^{\Lambda}e, assume p^{\Lambda}e < 2^{\Lambda}63 - 1, pe < 10^{\Lambda}6 // (n!)\_p = \Lambda tirlingfirst\{p\}\{1\}^{\Lambda}u f_{L}\{p,e\}(u) \Lambda um_{L}\{k=0\}^{\Lambda}\{e-1\} (up)^{\Lambda}k \Lambda tirlingfirst\{v\}\{u\}^{\Lambda}u \}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 f_{-}\{p,e\} = \prod_{i=0}^{i=0}^{i=0}^{i=0}^{i=1}(1 + \sum_{k=1}^{i=1}^{i=0}^{i=0}^{i=1}^{i=1}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^{i=0}^
                                                                                                                                                                                                                                                                                                                        inv, mod2) * mod1 + r1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 bool linear_equation(ll a, ll b, ll c, ll &x, ll &y)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 for (11 i = 2; i * i <= n; ++i) if (n % i == 0) {
                                                                                                                                                                                                             ull crt2(ull r1, ull mod1, ull r2, ull mod2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        rep(i, 1, e+1) pows[i] = (pe *= p);
ull period = pe / p * 2, deg = e * 2 - 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if (n > 1) ret = ret / n * (n - 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if (\_gcd(a, mod) != 1) return -1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  b /= g, a /= g, c /= g;
x = (x % b * (c % b) % b + b) % b;
y = (c - a * x) / b;
                                                                                                                                                                                                                                                                                                                                                                                                                              //ax + by = c, x >= 0, x is minimum
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  stirlingfirst\{p\}\{1\}\} (ip)^{\Lambda k}) ull fact_pe(ull n, ull p, ull e) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   ull pe = 1, min_pe = min(p, e);
                                                                                                                                                                                                                                                                                                                            return mul_mod(r2 + mod2 - r1,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                //xx = x + t * b, yy = y - t * a
                                                                                                                                                                                                                                                                      ull inv = mod_inv(mod1, mod2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           typedef unsigned long long ull;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                while (n \% i == 0) n /= i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              return s < 0 ? s + mod : s;
std::swap(s -= q * t, t);
                                                                                                              return s < 0? s + mod: s;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  11 b = mod, s = 1, t = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   ret = ret / i * (i - 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               ll mod_inv(ll a, ll mod) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if (c % g) return false;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      swap(a -= q * b, b);

swap(s -= q * t, t);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 // 求的欧拉函数值,简易版n
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 typedef __uint128_t dw;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              typedef vectorull> vl;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     v1 pows(e + 1, 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       11 euler_phi(11 n) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                exgcd(a, b, g, x, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           while (b) {
   ll q = a / b;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                +1}{k+1} \bmod p^e
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    factors
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       return true;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    11.4
```

```
ll val_id[maxn]; ///give the id, return the id—th number like 'n/i', (val\_id[1] = 1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int val_id_num_3; ///how many numbers like 'n/i' below n/n_3;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int val_id_num; ///how many numbers like 'n/i'
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             for(int j=1;j<=p_sz_2&&p[j]*i<=n_2;j++){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                          if(k==2) return n*(n+1)*(2*n+1)/6;
                                                                                                                                                                                                                                                                                                                                                                          ///return sum(i^{\Lambda}k), i from 1 to n.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         il f_p[maxn][3];///F_prime(id(n/i))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      int n_6; //(int)pow(n,1.0/6.0)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           int n_3; //(int)pow(n,1.0/3.0)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       val\_id[++val\_id\_num] = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                if(k==1) return n*(n+1)/2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if(i<=n_3) p_sz_3++;
if(i<=n_6) p_sz_6++;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               n_3 = (int)pow(n, 1.0/3.0);

n_6 = (int)pow(n, 1.0/6.0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if(i%p[j]==0) break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                memset(isp, 1, sizeof isp);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 for(int i=2;i<=n_2;i++){</pre>
                                                                                                                                                                                                              if(p==1||e==0) return 1;
                                                                                                                                                                                                                                                                                                return res*res+3*res+1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      p[++p_sz_2] = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       isp[i*p[j]] = 0;
                                                                                                                                                                                    inline 11 f(11 p,int e){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int n_2; ///(int)sqrt(n)
                                                                                                                                                                                                                                                                                                                                                pow_sum(11 n,int k){
                                                                                                                                                                                                                                                                    11 res = poww(p, e);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int p_sz_2; ///pi(n_2)
int p_sz_3; ///pi(n_3)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      n_2 = (int) sqrt(n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   int p_sz_6; ///pi(n_6)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             for(11 i=1;i<=n;){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               i = n/(n/(i+1))
                                                                                                                                                                                                                                                                                                                                                                                                         if(k==0) return n;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if(i==n) break;
                                                         //base %= mod,
                                                                                                                                                                                                                                             ///return f(p^e)
                            base *= base;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int p[200000+100];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    val\_id\_num = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if(isp[i]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     bool isp[maxn];
                                                                                                                                   return res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            isp[1] = 0;
                                                                                    b>>=1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  void init(){
                                                                                                                                                                                                                                                                                                                                                  1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              * f_p[][0/1/2/3/...] 分别代表质数个数 / 质数和 / 质数平方和 / 质数三次方和 /... 根据自己需要
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         ;加
例: 如果该函数在质数处表达式为 f(p) = p^2+3*p+1 ,则表明需要质数个数 / 质数和 / 质数平方和,
                                                                                                                                                                                                                                                                                        add = (dw)pows[ex] * prod % pe * inv[i] % pe * add % pe * f_pe[i] % pe;
ret = (ret + add) % pe;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                * f() 函数中 (31–37 行 ) 填函数在质数幂次处的表达式
* pow_sum() 函数中 (38–43 行 ) 填幂和函数(如果需要更高次的话可以在这里添加)
* 202–205 行按要求填写
                                                                                                                                                                                    ull j = deg - 1 - i, ex = v - vs[i] - cfac_vs[i] - cfac_vs[j];
                                                                             iprod = (dw)iprod * ((x - i) / pows[vs[i]]) % pe;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   auto fact_p = [&](ull u, ull v) {
    return (dw)fact_range(u, v) * evaluate(u) % pe;
                                                                                                                                                                                                                                       ull`add = (dw)cifac[j] * cifac[i] % pe;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if (ex & 1) ret = (dw)ret * fac % pe;
                        for (int i = deg - 1; i >= 0; --i) {
  inv[i] = (dw)iprod * inv[i] % pe;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                ret = (dw)ret * fact_p(u, v) % pe;
                                                                                                                                                                                                                                                                                                                                                                                                                                                        // ((up+v)!)_p \mod p^{\wedge}e: O(min(p, e))
                                                                                                                               ull ret = 0;
for (ull i = 0; i < deg; ++i) {</pre>
ull iprod = mod_inv(prod, pe);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for (ex %= period; ex; ex >>= 1)
                                                                                                                                                                                                                                                                    if (j & 1) add = pe - add;
                                                                                                                                                                                                            if (ex >= e) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    while (n > 0) {
  ull q = n / p, v = n % p;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   fac = (dw)fac * fac % pe;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      即 f_p[][0],f_p[][1],f_p[][2]
*/
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         const int maxn = 2000000+100
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       ull u = q \% period;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             ull ret = 1, ex = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               //res %= mod;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              ex += u, n = d;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   res *= base;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                poww(11 a,11 b){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            min 26
                                                                                                                                                                                                                                                                                                                                                                              return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   11 base = a;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if(b&1){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            11 \text{ res} = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              while(b){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            11.5
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else f_p[j][tt] = f_p[j][tt] - (f_p[get\_id(w)][tt]-sum(p[now-1]))*poww(p[now-1])
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if(wcn/n_3) f_p[j][tt] = f_p[j][tt] - (sum(get_id(w)) - sum(p[now-1]))*poww(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        f_p[j][k] = f_p[j][k] - val*(f_p[get_id(w)][k]-f_p[p[now-1]][k]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      add(1,f_p[1][tt]);
for(int i=2;val_id[i]<n/n_3;i++) add(i,f_p[i][tt] - f_p[i-1][tt]);
  for(int i=hd.k_max+1;hd.val*p[i]<n/n_3&&i<=p_sz_2;i++){</pre>
                                                                                                                                                                                    if(type==-1) nxt.f_val = hd.f_val*f(p[i],e);
                                                                                                                                                                                                                   else nxt.f_val = hd.f_val*poww(res,type);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                f_p[i][j] = pow_sum(val\_id[i], j)-1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   for(int j=val_id_num; j>=1; j---){
    l1 w = val_id[j]/p[now];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if(val_id[j]<n/n_3) break;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            for(int j=val\_id\_num;j>=1;j—){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  for(int k = 0; k < = times; k++){
                                                                                                                                                          nxt.val = hd.val*res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      for(int tt = 0;tt<=times;tt++){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   for(int i=1;i<=val_id_num;i++){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           //for(now=1;now<=p_sz_2;now++){
                                                                                 if(hd.val*res<n/n_3){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      ll\ w = val\_id[j]/p[now];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         for(int j=0;j<=times;j++){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    for(now=1;p[now]<=n_6;now++){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if(w<p[now]) break;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        for(;p[now]<=n_3;now++){</pre>
                                                                                                                                      nxt.k_max = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                        void get_f_p(ll n,int times){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if(w<p[now]) break;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           update_bfs(now,tt);
                                                    for(int e=1;;e++){
                                                                                                                                                                                                                                       q.push(nxt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int nnow = now, val = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         memset(c,0,sizeof c);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        val *= p[now];
                                                                                                                                                                                                                                                                                                                      res *= p[i];
                                                                                                           node nxt;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   p[now],tt);
                              11 res = p[i];
                                                                                                                                                                                                                                                                                              else break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         11 val=1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      ],tt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     ' moun = mon
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int now;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if((hd.val!=p[hd.k_max]&&type>=0)||type==-1) {//if(type==-1)cout << "***" << hd.
val << "****" << hd.f_val << endl;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       w = n/w;//cout << hd.val << "[" << w<" , " << val_id[val_id_num] << "]" <<
inline int get_id(ll k){ ///give a number like 'n/i', return the id of it
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               add(val_id_num+1,-111*hd.f_val);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              add(get_id(w),-111*hd.f_val);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if(type=-1)st.f_val = f(p[k], e);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           add(val_id_num+1,hd.f_val);
                              if(k>n_2) return val_id_num-n/k+1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         add(get_id(w),hd.f_val)
                                                                                                         11 c[maxn];
int lowbit(int n){return n & (-n);}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         else st.f_val = poww(i, type);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       for(ll i=p[k];i<n/n_3;i*=p[k]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  void update_bfs(int k,int type){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      while(!q.empty()) q.pop();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             node hd = q.front();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   11 w = n/hd.val;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if(type==-1){
                                                                                                                                                          void add(int x,11 d){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 while(!q.empty()){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            st.k_max = k;
                                                                                                                                                                                                                                         x+=lowbit(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                x==lowbit(x);
                                                                                                                                                                                      while(x<maxn){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      q.push(st);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          st.val = i;
                                                      else return k;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  dnene<node> d;
                                                                                                                                                                                                                                                                                                                                                                                                  ans+=c[x];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        end1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      node st;
                                                                                                                                                                                                                                                                                                                      sum(int \times){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          d.pop();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        else
                                                                                                                                                                                                                   c[x]+=q;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 return ans;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   int e = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int k_max;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      11 val;
11 f_val;
                                                                                                                                                                                                                                                                                                                                                 11 ans=0;
                                                                                                                                                                                                                                                                                                                                                                           while(x){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                struct node{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    6++;
```

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int kpow(int a, int b) {int r=1;for(;b;b>>=1,a=mul(a,a)) {if(b&1)r=mul(r,a);}return r;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            C 三种颜色染色,满足对所有边 u→>v 有 v 的颜色是 u 的下一种颜色
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    or(int i=1;i<=val_id_num;i++)    cout << val_id[i] << " : " << F[i] << endl;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                const int P = 1e9 + 7, N = 1e5 + 8; int add(int a, int b) {if((a += b) >= P) a -= P; return a < 0 ? a + P : a;} int mul(int a, int b) {return 111 * a * b % P;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        bool ok; int vis[N], n, m, u, v; ll use[N], ans; vi g[N], gg[N], tmp;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         * 1. 如果能染色且没用够三种颜色,不能增加边
* 2. 如果能染色且用了三种颜色,把点按颜色分为三类,三类点中相邻两类都有边
  for(int i=1;i<=val_id_num&&val_id[i]<n/n_3;i++) F[i] = sum(i);
                                                                                                                                                                                      11 _p = p[k];
while(val_id[now]/_p){
    F[now] += F[get_id(val_id[now]/_p)]*f(p[k],e);
                                                                                              for(int k=p_sz_6;k>=1;k--){
for(int now = val_id_num;now>=1;now--){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        * 2. 如果能染色且用了三种颜色,把点:
* 3. 如果不能染色,所有点之间都有边
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          vis[v] = inc(vis[u]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            三元闭包边计数
                                                                                                                                                                                                                                                                                p = p[k];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                tmp.pb(u);
for (auto v : g[u])
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              * 染色: 能用 A , B ,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if (x == 4) x = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if (x == 0) x = 3;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        * 对每一个弱连通子图:
                                                                                                                                                            int e = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if (!vis[v])
                                                             void get_f(11 n){
                                                                                                                                                                                                                                                                                                                   6++;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int inc(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int dec(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                get_f_p(n, 2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           三元闭包边计数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               void dfs(int u)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               get_f_3(n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           get_f_6(n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     cin >> n;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    return x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         return x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        get_f(n)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    init();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            11.6
                                                                                                                                                                                                                                                                                                                                           ///if f(p) = p \wedge 2 + 3p + 1, then write:f_p[i][0] = f_p[i][2] + 3 \cdot f_p[i][1] + f_p[i][0]; f_p[i][0] = f_p[i][2] + 3 \cdot f_p[i][1] + f_p[i][0];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             F[now] += f(p[pp],2) + (f(p[pp],1))*(f_p[get_id(val_id[now]/p[pp])][0]-f_p[
                                                                                                                                                                                        f_p[j][tt] = (f_p[get\_id(w)][tt]-f_p[p[now-1]][tt])*poww(p[now],tt);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 for(int pp=p_sz_3+1;p[pp]<=(int)(sqrt(val_id[now]))&&pp<=p_sz_2;pp++){
\textbf{for(int } i=1; i<=val\_id\_num&&val\_id[i]<n/n\_3; i++) \ f\_p[i][tt] = sum(i);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     F[now] += sum(get_id(val_id[now]/_p))*f(p[k],e);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      //cout << "*****" << p[k] << "*****" << n/n_3 << end];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        F[now] += F[get_id(val_id[now]/_p)]*f(p[k],e);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  update_bfs(k,-1);///bfs_to update [lpf(i)==P\{k-1\}]f(i)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         for(int i=2;val_id[i]<n/n_3;i++) add(i,F[i] - F[i-1]);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               F[now] = 1+(f_p[now][0]-f_p[q-1][0]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       F[now] = 1+(f_p[now][0]-f_p[q-1][0]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            void get_f_6(11 n){ ///V(F_{-}\{pi(n^{\wedge}(1/6))+1\},n)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                void get_f_3(11 n){ ///V(F_{-}{pi(n^{\prime}(1/3))+1}, n)
                                                                  for(int j=val_id_num;j>=1;j—){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for(int now=1;now<=val_id_num;now++){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       if(val_id[now]/_p>=n/n_3){
                                                                                                                           if(val_id[j]<n/n_3) break;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   for(;val_id[now]>=n/n_3;now—){
                                                                                            ll\ w = val\_id[j]/p[now]
                                                                                                                                                                                                                                                                                                            for(int i=1;i<=val_id_num;i++){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          for(int k=p_sz_3;k>p_sz_6;k--){
   int now = val_id_num;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     else if(val_id[now]<q*q){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            get_id(p[pp])][0]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     while(val_id[now]/_p){
                                                                                                                                                            if(w<p[now]) break;
                                     for(;now=p_sz_2;now++){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if(val_id[now]<q){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                memset(c,0,sizeof c)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              p^* = p[k];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               11 q = p[p_sz_3+1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  11 _p = p[k];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       if(k==1) break
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              F[now] = 1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int e = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           } else{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                      11 F[2000000+100];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    6++;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              add(1, F[1]);
```

```
b[0]/=3; b[1]/=2; b[4]-=3*b[0]; b[7]-=2*b[6]; b[8]-=2*b[6]; ans=0;
rep(i, 0, 9) ans += b[i] * c[i], b[i] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(j, 0, n) if (a[i][j]) res += (a[i] & a[j]).count();
res /= 2; b[8] += res * (res - 1) / 2;
                                                   rep(i, 0, n) rep(j, i+1, n) {
    int x = (a[i] & a[j]).count();
    if (a[i][j]) b[o] += x;
    b[1]+=f[X];
    if (a[i][j]) b[2]++;
    if (a[i][j]) b[4] += (d[i]-1)*(d[j]-1);
    if (a[i][j]) b[6] += f[X];
                                                                                                                                                                                                                                                           b[7] += f[x] * (d[i] + d[j] - 4);
d[i] = a[i].count();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   cout << ans << endl;
                                                                                                                                                                                                                                                                                                                                             b[3] += f[d[i]];
                                                                                                                                                                                                                                                                                                                                                                             b[5] += g[d[i]];
                                                                                                                                                                                                                                                                                                                                                                                                          11 res = 0;
                                                                                                                                                                                                                                                                                                                   rep(i, 0, n) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          return 0;
```

if (vis[v] != inc(vis[u])) ok = 0;

dfs(v);

}eIse

if (vis[v] != dec(vis[u])) ok = 0;

cin >> n >> m;

int main() {

vis[v] = dec(vis[u]);

dfs(v);

}else

for (auto v : gg[u]) {
 if (!vis[v]) {

込巻 ド大

```
inline int rk(int \ x) \ \{ \ return \ lower_bound(all(V), \ x) - V.begin(); \ \}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int cntn, cnt[N], ls[N], rs[N];
void init() { fill_n(rt+1, n, cntn = 0); }
void upd(int pre, int &now, int p, int c, int l, int r) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      static const int N = 2500005; //(::N + 32 * ::M) * 16;
                                                                                                                                                                                                                                                                                          // zoj 2112 动态区间 k 大 const int N = 50505, M = 10101;
                                                                                                                                                                                                                                                                                                                                        int n, m, a[N], rt[N<1];
vi V, add, sub;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int a, b, k;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    }q[M];
struct Seg {
                                                                                                                                                                                                                                                                                                                                                                                                                                                    bool op;
                                                                                                                                                                                                                                                                                                                                                                                                                          struct Q {
                                                                                                                                                                                                                                    11.8
                                                                                                                                                                                                                                                                                                          rep(i, 1, 4) ok &= use[i] > 0;
if (ok) ans += use[1] * use[2] + use[2] * use[3] + use[3] * use[1];
                                                                                                                                                                                                        if (!ok) { ans += 111 * sz(tmp) * sz(tmp);
                                                                                                                                                                                                                                                                                                                                                                                                                      for (auto u : tmp) ans += sz(g[u])
                                                                                                                                                                                                                                                            rep(i, 1, 4) use[i] = 0;
for (auto u : tmp) use[vis[u]]++;
                                                                                                                                                        ok = 1; tmp.clear(); vis[i] = 1;
                                                                                                                              rep(i, 1, n+1) if (!vis[i]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          cout << ans << endl;
                                                                                                                                                                                                                                                                                                                                                                                            int t = 0;
                        cin >> u >> v;
rep(i, 1, m+1) {
                                                                            (n)qd.[v]66
                                                    g[u].pb(v);
                                                                                                                                                                                                                                                                                                                                                                  else {
                                                                                                                                                                                  dfs(i);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return 0;
```

```
rep(i, 1, N) f[i] = i * (i-1) / 2, g[i] = i * (i-1) * (i-2) / 6; while (cin >> n){
                                                                                                                                                               bitset<n> a[N]; int n; string s; ll ans, b[9], f[N], g[N], d[N]; ll c[9] = \{24, 48, 2, 12, 6, 12, 36, 12, 24\};
                                                                                                                                                                                                                                                                                                                                                                            rep(j, 0, n) if (s[j] == '1') a[i] set(j);
                                                                                    // 六元环 = ( 只用走六步的所有方案 - ans) / 6
                                                                                                                                                                                                                                                                                            rep(i, 0, n) a[i].reset();
rep(i, 0, n) {
    cin >> s;
                                                            // ans = 非六元简单环计数
                                                                                                                                           const int N = 1e3 + 7;
大元环计数
                                                                                                                // time : 0(n^3 / 64)
                                                                                                                                                                                                                   int main(){
```

if(p<=mid) upd(ls[pre], ls[now], p, c, l, mid);
else upd(rs[pre], rs[now], p, c, mid+1, r);</pre>

cnt[now] = cnt[pre] + c;

now = ++cntn;

ls[now] = ls[pre];rs[now] = rs[pre];int mid = 1+r>>1;

if(1 == r) return;

int qry(int L, int R, int k, int l, int r) {
 if(1 == r) return l;

int mid = 1+r>>1;

for(auto i : add) lc += cnt[ls[i]];

1.9 动态树上路径 k 大

```
SZ
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   void upd(int p, int o, int c) \{ for(; p <= n; p += lb(p)) upd(fw[p], fw[p], c, o, 1, void upd(int p, int o, int c) \}
int n, m, L, dfn, val[N], rt[N], cnt[M], ls[M], rs[M], st[N], ed[N], fw[N], pair<int, pii> Q[N]; vi V, res[2], g[N]; LCARMQ R;
int F(int x) { return lower_bound(all(V), x) - V.begin() + 1; }
                                                                                                                       void upd(int &now, int pre, int p, int c, int 1, int r) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                upd(rt[u], rt[fa], F(val[u]), 1, 1, sz(V));
rep(i, 0, sz(g[u])) if(g[u][i] != fa) dfs(g[u][i], u);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int p = st[u]; for( ; p; p ^{\wedge}= lb(p)) res[o].pb(fw[p]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     rep(i, 0, sz(res[0])) res[0][i] = rs[res[0][i]];
rep(i, 0, sz(res[1])) res[1][i] = rs[res[1][i]];
return qry(k, mid + 1, r);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 0, sz(res[0])) res[0][i] = ls[res[0][i]];
rep(i, 0, sz(res[1])) res[1][i] = ls[res[1][i]];
                                                                                                                                                                                                                                                                                                                              if(p <= mid) upd(ls[now], ls[pre], p, c, l, mid);
else upd(rs[now], rs[pre], p, c, mid + 1, r);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int p = Q[i].se.fi, c = Q[i].se.se;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                upd(st[p], -1, F(val[p]));
upd(ed[p] + 1, 1, F(val[p]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         return qry(k — cntr, l, mid);
                                                                                                                                                                                                                                                                                                                                                                                                                          int qry(int k, int l, int r)
if(1 == r) return l;
                                                                                                                                                                               cnt[now] = cnt[pre] + c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          void dfs(int u, int fa) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    (V)); }
void upd(int u, int o) {
                                                                                                                                                                                                                                                                                                     int mid = 1 + r >> 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      int mid = 1 + r >> 1;
                                                                                                                                                                                                                                           rs[now] = rs[pre];
if(1 == r) return;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            dfs(1, 0);
rep(i, 1, m + 1) {
                                                                                                                                                                                                               ls[now] = ls[pre];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           res[o].pb(rt[u]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if(!Q[i].fi) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       if(cntr >= k) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      st[u] = ++dfn;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int cntr = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          // build 主席树
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  par[u] = fa;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                void solve() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         ed[u] = dfn;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            R.Build(g);
                                                                                                                                                        now = ++L;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     // fenwick
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  else {
```

```
if(q[i].op) { cout << V[fw.qry(q[i].a, q[i].b, q[i].k)] << endl;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                       0, sz(V)-1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               V.erase(unique(all(V)), V.end());
rep(i, 1, n+1) seg.upd(rt[i-1], rt[i], rk(a[i]), 1, 0, sz(V)-1);
rep(i, 1, m+1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                   for(; x<=n; x+=lb(x)) seg.upd(rt[x+n], rt[x+n], p, c,</pre>
                                                                                                                                                            rep(i, 0, sz(add)) add[i] = rs[add[i]];
rep(i, 0, sz(sub)) sub[i] = rs[sub[i]];
                                                    rep(i, 0, sz(add)) add[i] = ls[add[i]];
rep(i, 0, sz(sub)) sub[i] = ls[sub[i]];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             rep(i, 1, n+1) cin >> a[i], V.pb(a[i]); rep(i, 1, m+1) {
                                                                                                                                                                                                                return qry(L, R, k-lc, mid+1, r);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     return seg.qry(1, r, k, 0, sz(V)-1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  for(; x; x^{-1}b(x)) add pb(rt[n+x]);
for(auto i : sub) lc -= cnt[ls[i]];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      for(; x; x^=lb(x)) sub.pb(rt[n+x]);
                                                                                                                                                                                                                                                                                                                                                                               void init() { fill_n(rt+1+n, n, 0); }
void upd(int x, int p, int c) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           int p = q[i].a, c = q[i].b;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         V.clear(); seg.init(); fw.init();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      fw.upd(p, rk(a[p]), -1);
fw.upd(p, rk(a[p] = c), 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   string s;
cin >> s >> q[i].a >> q[i].b;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if(s[0]=='0') cin >> q[i].k;
else V.pb(q[i].b);
                                                                                                        return qry(L, R, k, l, mid);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             add.pb(rt[r]);sub.pb(rt[l-1]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int qry(int l, int r, int k) {
   add.clear();sub.clear();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         q[i].op = (s[0]=='Q');
                                                                                                                                                                                                                                                                                                                                                      #define lb(x) ((x)&(-x))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  cin >> n >> m;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int T; cin >> T;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             sort(all(V));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                } else {
                           if(lc>=k) {
                                                                                                                                                                                                                                                                                                                             struct Fenwick {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int \times = r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      while(T---) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    ///solve
                                                                                                                                     else {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 x = 1-1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        ///read
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                int main() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return 0;
                                                                                                                                                                                                                                                                                                        }sed;
```

```
w1[++t1] = cnt1, w2[t1] = cnt2;
r <= Sqr ? id1[r] = t1 : id2[n / r] = t1;
                                                                                                                                                                            if (k \& 1) ans -= h2(n/k/k) * mu[k];
                                                                                                for(int k = 1; k * k <= n; k++){</pre>
                                                                                                                           if (mu[k] == 0) continue;
                                                                                                                                                    ans += h1(n/k/k) * mu[k]
                                                                                                                                                                                                                                                                                                                                                                                                                                       cout << solve(nn) << endl;</pre>
                                                                                                                                                                                                                                                                                                                                                                                  rep(cas, 0, T) {
                                                                                                                                                                                                                                 return ans / 2;
                                                                                                                                                                                                                                                                                                                                                                                                             cin >> nn;
                                                                                                                                                                                                                                                                                                  int main() {
                                                                                                                                                                                                                                                                                                                                                          cin >> T;
                                                                                                                                                                                                                                                                                                                                 init();
                                                                                                                                                                                                                                                                                  int T, nn
                                                                                                                         int a = Q[i].se.fi, b = Q[i].se.se, k = Q[i].fi;
int c = R.lca(a, b), d = par[c];
upd(a, 0); upd(b, 0);
upd(c, 1); upd(d, 1);
                                                                                                                                                                                                                             cout << V[qry(k, 1, sz(V)) - 1] << end];
                                                upd(ed[p] + 1, -1, F(val[p]));
                                                                                                 rep(o, 0, 2) res[o].clear();
                                                                                                                                                                                                                                                                                                                                                                                            <u>-</u>
                         upd(st[p], 1, F(val[p]));
```

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val[p] = c;

else {

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```
return 0;
                                                                                                                                                                                              11.11
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       \
\\\\\
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  for(int i = 1; i * i < r; i++) cnt1 += sqrt(r - i * i);
for(int i = 1; i * i < r; i += 2) cnt2 += (sqrt(r - i * i) + 1) / 2;</pre>
                                                                    int w1[N * 2], w2[N * 2], id1[N * 2], id2[N * 2], t1;// 注意 longlong
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         ans += 111 * (n / 1) * (w2[id(r)] - w2[id(1-1)]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    ans += 111 * (n / 1) * (w1[id(r)] - w1[id(1-1)]);
                                                                                                                                                                                                                                                                                                                                                                                                        int id(int x) { return x <= Sqr ? id1[x] : id2[n / x];}</pre>
                                                                                                                                                                                                for(int j = 1; j <= tot && p[j] * i < N; j++){
  int u = p[j] * i;</pre>
                                                                                                                                                                                                                                                                                 0; break; }
                                                                                                                                                   rep(i, 2, N) {
    if (!vis[i]) p[++tot] = i,mu[i]=-1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             for(int \ 1 = 1, \ r; \ 1 <= n; \ 1 = r + 1){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       for(int 1 = 1, r; 1 <= n; 1 = r + 1){ r = n / (n / 1);
                                                                                                                                                                                                                                                   vis[u] = 1;
if(i % p[j] == 0) { mu[u] =
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 for(int l = 1, r; l \le n; l = r + 1){
 r = n / (n / 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int cnt1 = 0, cnt2 = 0;
                     int mu[N], p[N], tot = 0, Sqr,
                                                                                                                                                                                                                                                                                                      mu[u] = -mu[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  Sqr = Sqrt(n); t1 = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               r = n / (n / 1);
const int N = 34000
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             11 solve(int _n) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                             11 ans = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         return ans;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  11 ans = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                return ans;
                                                                                                                       mu[1] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      11 h2(int n){
                                                                                              void init(){
                                                                                                                                                                                                                                                                                                                                                                                                                                    11 h1(int n){
                                               bool vis[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      'u_ = u
```

```
bool has(int x){ return d and x \ge 1 and x \le r and x \% d == 1 \% d;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               \}; Seq operator -(int X, Seq S)\{return Seq(X - S.r,X - S.1, S.d);\}
                                                                                     int d = 0) : 1(1), r(r), d(d) {}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for (int i=1;i<=r;i+=d)list.pb(i);</pre>
const int N = 2e5 + 100, maxlog = 20;
                                                                                                                                                                          == 1){
                                                                                                                                                                                                                                                                                                                                 d = pos[1] - pos[0];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return (r-1) / d + 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if (d == 0)return list,
                                                                                Seq(int l = 0, int r = 0,
                                                                                                                                                                         }else if (pos.size()
                                                                                                                                                                                                                                                                                        1 = pos.front();
                                                                                                                                                                                                                                                                                                                                                                                                                      int count(){
   if (d == 0)return 0;
                                                                                                                                                                                                  1 = pos.front()
                                                                                                                                                                                                                        r = pos.front()
                                                                                                                                                                                                                                                                                                          r = pos.back();
                                                                                                                                                      1 = r = d = 0
                                                                                                                                if (pos.empty()){
                                                                                                      Seq(const vi & pos){
                                       /** 1 + K*d <=r **/
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    return list;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   vi list(0);
                                                                                                                                                                                                                                         d = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               to_list(){
                                                           int 1, r, d;
                                                                                                                                                                                                                                                                   }else{
                      struct Seq{
```

```
for (int step = 0;(1<step) < r - 1 + 1;step++) ret.pb(get_border(1,r,step));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int last = upper_bound(list.begin(), list.end(),r) - list.begin() - 1;
                                                                                                                                                                                                                                                                          int idx = lower_bound(list.begin(),list.end(),l) - list.begin();
while (idx < list.size() && pos.size() < 3 && list[idx] <= r){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              Seq seq1 = get_seq(pos[step][name1],r - giant + 1,r - baby + 1),
seqr = get_seq(pos[step][namer],1,1 + giant - baby);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int L = pos.front(), d = pos[1] - pos[0], R = list[last]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int name1 = name[1][step], namer = name[r - baby + 1][step];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int baby = 1 << step, giant = min(len-1, (baby * 2-1));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             seq1 = (r + 1) - seq1; seqr = seqr - (1 - baby);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 * Attention: can contain empty sequence (0,0,0)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    printf("%d\n", dbf.get_biggest_border(1, r));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      * if \lceil 2^{\wedge}i, 2^{\wedge}(i+1) \rceil border does not exist.*/
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 /** return O(logn) border series of S[l,r].
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     vector<Seq> get_border_series(int l,int r){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          for (int k = \max \log - 1; k \ge 0; k \longrightarrow 0
                                                                                                                                                                                                                                                                                                                                                                                                             if (pos.size() < 3)return Seq(pos);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  Śeq get_border(int l,int r,int step){
                                                                                                                                                                                                     Seq get_seq(vi & list, int l, int r){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if ((1<<k) >= len)continue;
Seq seq = get_border(l,r,k);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           int get_biggest_border(int l,int r){
                               pos[step][rk[i]].pb(i);
                                                                                                                                                                   // get sequence [2^step, 2^(step+1))
  name[i][step] = rk[i];
                                                                                                                                                                                                                                                                                                                                           pos.pb(list[idx]);idx ++;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if (seq.r)return seq.r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 return Seq(L, R, d);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                int len = r - 1 + 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 scanf("%d%d", &1, &r);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int len = r - 1 + 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return seql & seqr;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             vector<Seq> ret(0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      scanf("%d%d", &n, &q);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              scanf("%s", s + 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       char s[N]; int n,q;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           dbf.init(s, n);
                                                                                                                                                                                                                                               vi pos(0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             while (q—){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int 1,r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int main(){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          }dbf;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if (A[sa[i]] != A[sa[i-1]] || B[sa[i]] != B[sa[i-1]])rk[sa[i]] ++;
                                                                                                                                                                                                                                                                                                                                                                                                                                             int 1 = max(S1.1,S2.1), r = min(S1.r,S2.r);
if (r >= 1 && S1.1 % S1.d == S2.1 % S1.d)return Seq(1,r,S1.d);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int name[N][maxlog], cntA[N],cntB[N],tsa[N],A[N],B[N], sa[N],rk[N];
void init(char *ch, int n){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       for (int i=n;i>=1;i--)sa[cntA[A[tsa[i]]]--] = tsa[i];
  - x, S.d);}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               for (int i=0;i<=n;i++)cntA[i] = cntB[i] = 0;
for (int i=1;i<=n;i++){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        for (int i=1;i<=n;i++)cntB[i] += cntB[i-1];</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            for (int i=1;i<=n;i++)cntA[i] += cntA[i-1];</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if (ch[sa[i]] != ch[sa[i-1]])rk[sa[i]] ++;
Seq operator -(\text{Seq S}, \text{ int X})\{\text{return Seq(S.1}-X, S.r. Seq operator &(Seq S1, Seq S2)}\}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  for (int i=n; i>=1; i—)sa[cntA[ch[i]]—] = i;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                for (int step = 1,1=1;1 <= n;1<<=1,step ++){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 pos[step].resize(rk[sa[n]] + 1,vi (0));
                                                                                            if (cnt1 == 0 || cnt2 == 0) return Seq(0,0,0);
if (cnt1 > cnt2) swap(S1,S2), swap(cnt1,cnt2);
if (cnt1 < 3){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               for (int i=1;i<N;i++)cntA[i] += cntA[i-1];</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     for (int i=n;i>=1;i--)tsa[cntB[B[i]]--
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 cntB[B[i]=(i+l<=n)?rk[i+l]:0]++;
                                                                 int cnt1 = S1.count(), cnt2 = S2.count();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                for (int i=1;i<=n;i++)cntA[ch[i]]++;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       pos[0].resize(rk[sa[n]] + 1,vi(0));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rk[sa[i]] = rk[sa[i–1]];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      cntA[A[i] = rk[i]] ++;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    for (int i = 1;i <=n;i++){
                                                                                                                                                                                                                                                                          if (S2.has(x)) pos.pb(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          struct Dictionary_of_Basic_Factories{
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      rk[sa[i]] = rk[sa[i-1]];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           for (int i=2;i<=n;i++){</pre>
                                                                                                                                                                                                                                          for (int \times : S1.to_list()){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               else return Seq(0,0,0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           pos[0][rk[i]].pb(i);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 for (int i=2;i<=n;i++){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            (int i=1;i<=n;i++)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         name[i][0] = rk[i]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           ch[0] = ch[n+1] = -1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    vector<vi> pos[maxlog];
                                                                                                                                                                                                                                                                                                                                                                        rk[sa[1]] = 1;
                                                                                                                                                                                                                                                                                                                                           return Seq(pos);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      }else assert(0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      rk[sa[1]] = 1;
                                                                                                                                                                                                  vi pos(0);
                                                                                                                                                                        (cnt1 < 3){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          /** 1-base **/
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            for
```

```
for (int j = id[i]; j; j = fail[up[j]]) {
   int l = max(1, Seg.query(1, 1, dfn, in[j], out[j]) - len[j] + 2);
   int r = i - len[up[j]] + 2;
   BT.updata(1, 1); BT.updata(r, -1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              void build() { for (int i=0; i< p; i++)if (i:=1) G[fail[i]].pb(i); } void dfs(int x=1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          for (int i = 1; i <= m; i++) scanf("%d%d", &l, &r), Q[r].pb(mp(l, i));
                                                                                                                                                                                                                                                   next[cur][c] = now;
d[now] = len[now] - len[fail[now]];
up[now] = (d[fail[now]] == d[now] ? up[fail[now]] : now);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          for (auto j : Q[i]) ret[j.se] = BT.sum(j.fi);
                                                                                                                                                                                                fail[now] = next[get_fail(fail[cur])][c];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   rep(i, 1, m + 1) printf("%lld\n", Space::ret[i]);
return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    for (int i = 1; i <= n; i++) A.add(s[i], i);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           Seg.updata(1, 1, dfn, in[id[i]], i);
                                                                                                  if (!next[cur][c]) {
  int now = newnode(len[cur] + 2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     void solve() {
  for (int i = 1; i <= n; i++) {</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       for (auto i : G[x]) dfs(i);
                                           int cur = get_fail(last);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                last = next[cur][c];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            O(nlogn^2), 下标从 1 开始
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   void work(int n, int m)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  scanf("%s", s + 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 scanf("%d%d", &n, &m);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               id[cc] = last;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            in[x] = ++dfn;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  out[x] = dfn;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                Space::work(n, m);
s[++u] = c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   A.build();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 A.solve();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int n, m, l, r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             A.init();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              A.dfs();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 /*注: 离线算法
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int main() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      12 5
abcddcbaabcd
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        1 4
1 8
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if (fr <= t) return query(x << 1, 1, t, fl, fr);
else if (fl > t) return query(x << 1 | 1, t + 1, r, fl, fr);
else return max(query(x << 1, l, t, fl, t), query(x << 1 | 1, t + 1, r + 1, 
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           void updata(int x, int y) { for (int i = x; i < N; i += i\&-i)d[i] += y; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       // r 为结尾的回文串的长度一定可以分成 1ogn 段等差数列
                                                                                                                                                                                                                                                                                                                                                                                                                 char s[N]; int m, n, l, r; ll ans = 0, ret[N]; vector<pii> Q[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int next[N][26], fail[N], len[N], s[N], id[N], last, n, p;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int res = 0; for (int i = x; i; i = i\&-i)res += d[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    void updata(int x, int 1, int r, int pos, int y) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          while (s[n - len[x] - 1] != s[n]) x = fail[x],
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int query(int x, int l, int r, int fl, int fr) {
   if (l == fl && r == fr) return a[x];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if (pos <= t) updata(x << 1, 1, t, pos, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             for (int i = 0; i < 26; ++i) next[p][i] = 0,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                else updata(x << 1 \mid 1, t + 1, r, pos, y); a[x] = max(a[x << 1], a[x << 1 \mid 1]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int in[N], out[N], d[N], up[N], dfn = 0; vector<int> G[N]; // dfs \not F
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        last = n = 0; s[n] = -1; fail[0] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       if (1 == r) \{ a[x] = y; return; \}
int t = (1 + r) >> 1;
                                                                                                                                                                                            区间本质不同回文子串计数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             p = 0; newnode(0); newnode(-1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               inline void add(int c, int cc) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           inline int get_fail(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              inline int newnode(int 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int t = (1 + r) >> 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      inline void init() {
                                                                                                                                                                                                                                                                                                                          namespace Space {
  const int N = 600005;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int sum(int x)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             len[\dot{p}] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           int a[N << 2];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     return res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        return p++;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                        struct SegTree {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         return x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 struct BIT {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      struct PAM {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int d[N]
                                                       return 0;
                                                                                                                                                                                                    11.12
```

```
for (R int mid = 1; mid < lim; mid <<= 1) for (R int j = 0; j < lim; j += (mid << 1))</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                      rep(i, 0, len - 1) f[i] = cp(a[i] >> 16, a[i] & 65535), g[i] = cp(b[i] >> 16, b[i] & 65535)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(i, 0, lim - 1) \\ c[i] = ((((l1)(p[i].x + 0.5) % P << 16) % P << 16) + ((l1)(q[i].x + 0.5) << 16)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      \begin{array}{l} t = -f[i\ ?\ lim-i\ :\ 0], \ f0 = (f[i]-t)\ ^*\ cp(0,\ -0.5), \ f1 = (f[i]+t)\ ^*\ 0.5; \\ t = -g[i\ ?\ lim-i\ :\ 0], \ g0 = (g[i]-t)\ ^*\ cp(0,\ -0.5), \ g1 = (g[i]+t)\ ^*\ 0.5; \\ p[i] = f1\ ^*\ g1, \ q[i] = f1\ ^*\ g0 + f0\ ^*\ g1 + f0\ ^*\ g0\ ^*\ cp(0,\ 1); \\ \end{array} 
                                                                                                            + k + mid] = A[j + k] - (t = w[ty][mid + k] * A[j + k + mid]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 rep(i, 0, n) f[i] = mul(a[i], mul(ifac[i], ifac[n - i])); for (R int i = n - 1; i >= 0; i == 2) f[i] = P - f[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      fd(i, n + n, 1) isum[i - 1] = mul(isum[i], g[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               rep(i, 1, n + n) g[i] = mul(isum[i], sum[i - 1]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             rep(i, 1, n + n) sum[i] = mul(sum[i - 1], g[i]);
                                                                                                                                                                                                                                                                 if (!ty) rep(i, 0, lim - 1) A[i] = A[i] * iv[d];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  static int f[N], g[N], h[N], sum[N], isum[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               fd(i, n, 1) isum[i - 1] = mul(isum[i], g[i]); rep(i, 1, n) g[i] = mul(isum[i], sum[i - 1]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(i, len, lim - 1) f[i] = g[i] = cp(0, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        rep(i, 1, n) = sum[i] = sum(sum[i - 1], g[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 0, n) g[i] = (0ll + P + p1 + i) % P; sum[0] = g[0];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    int res = 1, p1 = k - n, p2 = k;
ron(i n1 n2) res = 111 * res * i % P;
                                                                                                                                                                                                                                                                                                                                                (c)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                isum[n + n] = ksm(sum[n + n], P - 2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     void calc(int *a, int *b, int n, int k)
                                                                                                                                                                                                                                                                                                                                       void MTT(int *a, int *b, int len, int
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      rep(i, 0, n + n) g[i] = add(i, t);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           rep(i, n + 1, len – 1) f[i] = 0;
rep(i, n + n + 1, len – 1) g[i] =
                                                                                                                                                                                                                                                                                                                                                                                static cp f[N], g[N], p[N], q[N];
lim = len, d = lg[lim];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    while (len <= n + n) len <<= 1;
                                                                                                                                                        +
t;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         ((11)(q[i].y + 0.5)) % P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           isum[n] = ksm(sum[n], P - 2);
                                                                                                               A[j + k + mid] = A[j 
A[j + k] = A[j + k]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 cp t, f0, f1, g0, g1;
                                                                            rep(k, 0, mid - 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     FFT(f, 1), FFT(g, 1); rep(i, 0, \lim_{} - 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             FFT(p, 0), FFT(q, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                int t = dec(k, n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          MTT(f, g, len, h);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      res = add(res, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     g[0] = isum[0];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         sum[0] = g[0];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int len = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            65535);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       inline cp operator+(const cp &b) const { return cp(x+b.x, y+b.y); } inline cp operator-(const cp &b) const { return cp(x-b.x, y-b.y); } inline cp operator*(const cp &b) const { return cp(x-b.x, y-b.y); } inline cp operator*(const cp &b) const { return cp(x*b.x-y*b.y, x*b.y, x*b.y+y*b.y)}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(i, 2, 131072) inv[i] = mul(P - P / i, inv[P % i]), ifac[i] = mul(ifac[i - 1], inv
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       inline int add(R int x, R int y) { return 011 + x + y >= P ? 011 + x + y - P : x + y; } inline int dec(R int x, R int y) { return x - y < 0? x - y + P : x - y; } inline int mul(R int x, R int y) { return 111 * x * y - 111 * x * y / P * P; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             rep(i, 0, (1 << d) - 1) r[d][i] = (r[d][i >> 1] >> 1) | ((i \& 1) << (d-1)); lg[1 << d] = d, iv[d] = iv[d - 1] * 0.5;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                  #define R register #define fd(i, a, b) for (R int i = (a), I = (b)-1; i > I; —i) #define go(u) for (int i = head[u], v = e[i].v; i; i = e[i].v, v = e[i].v)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         inline cp operator*(const double &b) const { return cp(x * b, y * b); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     for (; y; y >>= 1, x = mul(x, x)) (y & 1)? res = mul(res, x) : 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      for (R int i = 1, d = 0; i < 131072; i <<= 1, ++d) rep(k, 0, i
w[1][i + k] = cp(cos(Pi * k * iv[d]), sin(Pi * k * iv[d]));
w[0][i + k] = cp(cos(Pi * k * iv[d]), -sin(Pi * k * iv[d]));</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 inline cp(R \text{ double } xx = 0, R \text{ double } yy = 0) : x(xx), y(yy) {}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             rep(i, 0, lim - 1) if (i < r[d][i]) swap(A[i], A[r[d][i]]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               inline cp operator~() const { return cp(x, -y); }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        int r[21][N], ifac[N], lg[N], inv[N]; double iv[21];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          = ifac[0] = ifac[1] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     const double Pi = a\cos(-1.0)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    const int N = (1 << 17) + 5;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int ksm(R int x, R int y) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          void FFT(cp *A, int ty) {
                                                                                                                                                                                                                                                                                                                                                                             大阶乘取模
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    rep(d, 1, 17) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          inv[0] = inv[1]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     R int res = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           double x, y;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              return res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 void Pre() {
  iv[0] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              struct cp {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int lim, d;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     } w[2][N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         ......
1 12
                                                                                                                  74871
```

带花树最大权匹配 11.14

int solve(int bl) {

int s = 0;

a[0] = 1, -s;

if (p) {

p <<= 1;

g[0] = isum[0];

```
int n, n_x, lab[M], match[M], slack[M], st[M], pa[M], flower_from[M][N+1], S[M], vis[M];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           for(int u=1;u<=n;++u) if(g[u][x].w>0&&st[u]!=x&&S[st[u]]==0) update_slack(u,x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if(x>n) for(size_t i=0;i<flower[x].size();++i) set_st(flower[x][i],b);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              inline int get_pr(int b,int xr){
   int pr=find(flower[b].begin(),flower[b].end(),xr)-flower[b].begin();
   if(pr%2==1){ // 检查他在前一层图是奇点还是偶点
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rotate(flower[u].begin(),flower[u].begin()+pr,flower[u].end());
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     else for(size_t i=0;i<flower[x].size();i++)q_push(flower[x][i]);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int xr=flower_from[u][e.u], pr=get_pr(u, xr);
for(int i=0;i<pr:++1)set_match(flower[u][i], flower[u][i^1]);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                      E g[M][M]; vi flower[M]; queue<int> q;
inline int e_delta(const E &e){ // does not work inside blossoms
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        reverse(flower[b].begin()+1,flower[b].end());
                                  // 求的是在权最大情况下的匹配权值大优先应该要是正数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   return lab[e.u]+lab[e.v]-g[e.u][e.v].w*2;
                                                                                                                                                                                                                                                                                                                          E(int u, int v, int w):u(u), v(v), w(w){}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        return (int)flower[b].size()—pr;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    inline void set_match(int u,int v){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          inline void augment(int u,int v){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  inline void set_st(int x,int b){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               inline void set_slack(int x){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      int xnv=st[match[u]];
                                                                                                 // time : 应该也是 O(n^3)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(x \le n) q.push(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      match[u]=g[u][v].v;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                set_match(xr,v);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        set_match(u,v);
                                                                                                                                     #define INF INT_MAX
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            }else return pr;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        void q_push(int x)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 E e=g[u][v];
       // from vfleaking
                                                                    // id : 1 .. n
                                                                                                                                                                                                #define M N*2+1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 slack[x]=0;
                                                                                                                                                                   #define N 600
                                                                                                                                                                                                                                                             int u, v, w;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            for(;;){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if(u>n){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       st[x]=b;
                                                                                                                                                                                                                                  struct E{
                             b[i] = mul(h[i + n], res), res = mul(res, mul(g[i], p2 + 1));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     P.;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(i, 1, p) a[p] = mul(a[p], (111 * b1 * p + i) %
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     rep(i, 0, p) a[i] = mul(a[i], (111 * b1 * i)
for (R int i = 0; i \le n; p2 = add(p2, 1), ++i)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int res = ksm(GetFac(P - 1 - n), P - 2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 0, p) a[i] = mul(a[i], b[i]);
                                                                                                                                                                                                                                                                                                                                               calc(a, b, p, p + 1);
rep(i, 0, p) a[p + i + 1] = b[i];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int res = 1;
rep(i, 0, bl - 1) res = mul(res, a[i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            rep(i, s * s + 1, n) res = mul(res, i);
                                                                                                                                                                                                                                                                                                                                                                                                                                            calc(a, b, p << 1, mul(p, qwq));
                                                                                                                                                                                        for (int p = b1; p; p >>= 1) ++S;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int s = sqrt(n), res = solve(s);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      scanf("%d%d", &n, &P), Pre();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              return n & 1? res : P - res;
                                                                                                                                                                                                                                                                                   For (int p = 0; s >= 0; —s) {
                                                                                                                         static int a[N], b[N], c[N];
                                                                                                                                                                                                                                                     int qwq = ksm(b1, P - 2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     printf("%d\n", Fac(n))
                                                                                                                                                                                                                                                                                                                                                                                                               a[p \ll 1 \mid 1] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       p = 1, a[p] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             }
if (bl >> s & 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if (n >= P) return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 (n > P - 1 - n)
```

int GetFac(int n) {

return res;

int Fac(int n) {

if

return res;

return GetFac(n);

scanf("%d", &T);

int main() {

int n;

int T;

while (T—)

return 0;

```
for(int x=1;x<=n_x;++x) if(st[x]==x&&slack[x]&&st[slack[x]]!=x&&e_delta(g[slack[x]]) = x&&e_delta(g[slack[x]]) = x&e_delta(g[slack[x]]) = x&e_de
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          for(int b=n+1; b<=n_x; ++b) if(st[b]==b&&S[b]==1&&lab[b]==0) expand_blossom(b);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   for(int x=1;x<=n_x;++x) if(st[x]==x&&!match[x]) pa[x]=0,S[x]=0,q_push(x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for(int b=n+1;b<=n_x;++b) if(st[b]==b&&S[b]==1) d=min(d,lab[b]/2);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             for(int v=1;v<=n;++v) if(g[u][v].w>0&&st[u]!=st[v]){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   else if(S[x]==0)d=min(d,e_delta(g[slack[x]][x])/2);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  for(int x=1;x<=n_x;++x) if(st[x]==x&&slack[x])</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if(S[x]==-1)d=min(d,e_delta(g[slack[x]][x])
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if(!lca)return augment(u,v), augment(v,u), true;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if(on_found_E(g[slack[x]][x]))return true;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if(on_found_E(g[u][v]))return true;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    for(int b=n+1;b<=n_x;++b) if(st[b]==b){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 } else update_slack(u,st[v]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         else if(S[st[b]]==1)lab[b]—=d*2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        }else if(S[st[u]]==1)lab[u]+=d;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           memset(slack+1,0,sizeof(int)*n_x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(S[st[b]]==0)lab[b]+=d*2;
                                                                                                            inline bool on_found_E(const E &e){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if(e_delta(g[u][v])==0)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if(lab[u]<=d)return 0;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   memset(S+1,-1, sizeof(int)*n_-X);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int u=q.front();q.pop();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if(S[st[u]]==1)continue
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  else add_blossom(u,lca,v);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if(q.empty())return false;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           for(int u=1;u<=n;++u){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      int lca=get_lca(u,v);
                                                                                                                                                                    int u=st[e.u],v=st[e.v];
                                                                                                                                                                                                                                                                                                                                                                                                 slack[v]=slack[nu]=0;
                                                                                                                                                                                                                                                                                                                                             int nu=st[match[v]];
                                                                                                                                                                                                                                                                                                                                                                                                                                                 S[nu]=0, q_push(nu);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if(S[st[u]]==0){
                                                                                                                                                                                                                                                                                pa[v]=e.u, S[v]=1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               inline bool matching()
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            while(q.size()){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 d=dueue<int>();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  }else if(S[v]==0){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        d=dnene<int>();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  ]][x])==0)
                                                                                                                                                                                                                        if(S[v]==-1){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   return false;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      int d=INF;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               return false;
st[b]=0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            \textbf{for(int} \ x=u,y;x!=lca;x=st[pa[y]]) \ flower[b].pb(x), \ flower[b].pb(y=st[match[x]]),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    reverse(flower[b].begin()+1,flower[b].end());
for(int x=v,y;x!=lca;x=st[pa[y]]) flower[b].pb(x), flower[b].pb(y=st[match[x]]),
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  \textbf{for}(\textbf{int} \ x=1; x<=n\_x; ++x) \ \textbf{if}(g[b][x].w==0| |e\_delta(g[xs][x]) < e\_delta(g[b][x]))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               for(size_t i=0,i<flower[b].size();++i) set_st(flower[b][i],flower[b][i]);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for(int x=1,x<=n;++x) if(flower_from[xs][x]) flower_from[b][x]=xs;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   int xr=flower_from[b][g[b][pa[b]].u],pr=get_pr(b,xr);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         for(int x=1;x<=n_x;++x)g[b][x].w=g[x][b].w=0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           inline void expand_blossom(int b){ // S[b] == 1
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      inline void add_blossom(int u,int lca,int v){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 for(size_t_i=pr+1;i<flower[b].size();++i){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        int xs=flower[b][i],xns=flower[b][i+1];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             vis[u]=t; // 这种方法可以不用清空 v 数组
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             for(int x=1; x<=n; ++x)flower_from[b][x]=0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          [p][x]=a[xs][x] (x][p]=a[x][x];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          For(size_t i=0;i<flower[b].size();++i){
                                                   set_match(xnv, st[pa[xnv]]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         slack[xs]=0, set_slack(xns);
                                                                                                                                                                                                                                                                                inline int get_lca(int u,int v){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      S[xs]=-1, set_slack(xs);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if(vis[u]==t)return u;
                                                                                                                                                                                                                                                                                                                                                                                             for(++t;u|v;swap(u,v))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              while(b<=n_x&&st[b])++b;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int xs=flower[b][i];
                                                                                                                u=st[pa[xnv]], v=xnv;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            pa[xs]=g[xns][xs].u;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                for(int i=0;ii+=2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int xs=flower[b][i]
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             S[xr]=1, pa[xr]=pa[b],
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if(u)u=st[pa[u]];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            match[b]=match[lca];
                                                                                                                                                                                                                                                                                                                                                                                                                                                     if(u==0)continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         S[xs]=1, S[xns]=0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     u=st[match[u]];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        flower[b].clear();
    if(!xnv)return;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            flower[b].pb(lca)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            lab[b]=0,S[b]=0;
                                                                                                                                                                                                                                                                                                                                             static int t=0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if(b>n_x)++n_x;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          (sux)ysnd_b
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               set_slack(b);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      set_st(b,b);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         q_push(y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   int b=n+1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  d_push(y)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   return 0;
```

```
if (x & u) g[i] = sub(g[i], mul(f[x], g[i ^ x]));
                                                                                                                                                                                                                                                                                                                                                                          for (int x = (i - 1) \& i; x > 0; x = (x - 1) \& i) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 f[i] = sub(f[i], mul(g[x], p[cal(i \land x, i)]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                   f[i] = p[cal(i, i)];
for (int x = i; x > 0; x = (x - 1) & i) {
                                                                                                                                                                                                                                                                               rep(i, 1, m+1) p[i] = mul(p[i-1], 2);
rep(i, 1, S+1) {
    u = i & (-i);
                                                                                                                                                                                      S = pw(n) - 1;
rep(i, 1, S+1) cnt[i] = get(i);
p[0] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        using ull = unsigned long long;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           g[i] = add(g[i], f[i]);
                                                                                                                       a[pw(u-1)] | = pw(v-1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           using uint128 = __uint128_t;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       using uint = unsigned int;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   \mathbf{Rho}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       using 11 = 1ong long,
                                                           rep(i, 1, m+1) {
cin >> u >> v;
                                 cin >> n >> m;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         cout << f[S];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 快速
int main() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      11.16
                                                                                                                                                                                                                                                                                                                                                                                                                                      \textbf{for}(\textbf{int} \ u=1; u <= n; ++u) \ \textbf{if}(\texttt{match}[u] \& \texttt{match}[u] < u) \ \texttt{tot\_weight} += g[u][\texttt{match}[u]] \cdot w;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                for(int u=1;u<=n;++u) for(int v=1;v<=n;++v) g[u][v]=E(u,v,0);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            for(int u=1;u<=n;++u)printf("%d ",match[u]);puts("");
                                                                                                                                                                                      for(int u=0;u<=n;++u)st[u]=u,flower[u].clear();</pre>
                                                                                                                                                                                                                                                  for(int u=1;u<=n;++u) for(int v=1;v<=n;++v){</pre>
                               inline pair<long long,int> weight_blossom(){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               printf("%lld\n",weight_blossom().first);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int u, v, w; scanf("%d%d%d", &u, &v, &w);
                                                                                                                                                                                                                                                                                                                                                                            for(int u=1;u<=n;++u)lab[u]=w_max;</pre>
                                                              memset(match+1, 0, sizeof(int)*n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                          return mp(tot_weight,n_matches);
                                                                                                                                                                                                                                                                                   flower_from[u][v]=(u==v?u:0);
                                                                                                                                                                                                                                                                                                              w_max=max(w_max,g[u][v].w);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               inline void init_weight_graph(){
                                                                                                                                                                                                                                                                                                                                                                                                         while(matching())++n_matches;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int m; scanf("%d%d",&n,&m);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      g[u][v].w=w.[u][v]g=w.[v][u]g
                                                                                                                                                         long long tot_weight=0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       for(int i=0;i<m;++i){</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           init_weight_graph();
                                                                                                                          int n matches=0;
                                                                                                                                                                                                                     int w max=0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int main(){
```

```
Mod operator += (const Mod& rhs) { if ((x += rhs.x) >= mod) \times -= mod; return *this
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        Mod operator -= (const Mod& rhs) { if (sT(x -= rhs.x) < 0) \times += mod; return *this;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    Mod operator *= (const Mod& rhs) \{ x = reduce(dT(x) * rhs.x); return *this; \}
                                                                                                                                                                                                                                    T \gcd(T \ a, \ T \ b) \ \{ \ \text{while} \ (b) \ \{ \ T \ t = a \% \ b; \ a = b; \ b = t; \ \} \ \text{return} \ a; \ \}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               Mod operator + (const Mod &rhs) const { return Mod(*this) += rhs; }
Mod operator - (const Mod &rhs) const { return Mod(*this) -= rhs; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      bool operator == (const Mod& rhs) const { return x == rhs.x; }
bool operator != (const Mod& rhs) const { return x != rhs.x; }
                                                                                                          inline uint isqrt(ull x) { return sqrtl(x); }
inline uint ctz(ull x) { return __builtin_ctzll(x); }
                                                                    inline ull sqr(ull \times) { return \times * \times; }
                                                                                                                                                                                                                                                                                                                                                                                                    static T mod, inv, r2;
static const int wb = sizeof(T) * 8;
                                                                                                                                                                                                                                                                                                                     template <class T, class dT, class ST>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   Mod(T_x): x(init(x)) {}
using pli = pair<ull, uint>;
                                                                                                                                                                                                     template <class T>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           {} (0)x :()pow
                                     namespace prime {
                                                                                                                                                                                                                                                                                                                                                                 struct Mod
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           ×
                                                                                                                                                      然后把枚举出度为零的点集容斥改为枚举缩点后出度为零的点集容斥
                                                                                                                                                                                                                              int n, cnt[N], S, g[N], f[N], u, v, a[N], m, p[300];
int get(int x) {
                                                                                                                                                      // 首先要会 n 点 m 边 DAG 计数,
                  强连通子图计数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     res += cnt[a[t] & y];
                                                                                                             // n 点 m 边强连通子图计数
                                                                                                                                                                                                     const int N = 1 << 15;
                                                                                                                                                                                                                                                                                                                                                                                                                                               x = (x - 1) \& x;
```

int cal(int x, int y)

return res;

int res = 0;

11.15

while (x) {

res++;

int res = 0, t; while (x) {

t = x & (-x);

 $x \wedge = t;$

return res;

```
×
|
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if (g == 1) continue;
if (g == n) for (g = 1, y = sy; g == 1; ) <math>y = y * y + mc, g = gcd(n, (y == n))
                                                                                                                                                                                                                                                                if (n < (1u << 31)) return !composite uint, Mod32>(n, bases[x], y);
                                                                                                                                                                                                                                                                                                                                                                                                                                    ExactDiv(ull n) : n(n), i(Mod64::mul_inv(n)), t(ull(-1) / n) {}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                     friend ull operator / (ull n, ExactDiv d) { return n * d.i; };
bool divide(ull n) { return n / *this <= t; }</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          .;
o
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  for (uint i = 2; i <= sqrt_n; ++i) if (is_prime[i]) {
   if (i != 2) primes.pb(ExactDiv(i));
   for (uint j = i * i; j <= n; j += i) is_prime[j] =</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          for (int i = 0; i < (int)min(s, 1 - k); ++i) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if (n < (1u << 31)) return brent<uint, Mod3\geq(n, c);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              auto x = y;
for (int i = 0; i < (int)1; ++i) y = y * y + mc;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        T brent(T n, T c) { // n must be composite and odd
const ull s = 256;
                                                                                                                                                                                                                                                                                                      return !composite<ull, Mod64>(n, bases[x], y);
                                                                                                                                                                                                                                    else if (n < 3770579582154547) \times = y = 5;
                                                                                                                                                                                                     (n < 47636622961201) \times = y = 4;
                                                                                                                                else if (n < 4759123141) \times = 2, y = 3;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             for (int k = 0; k < (int)1; k += s)
                                                                                                                                                                 (n < 154639673381) \times = y = 3;
                                                                                              else if (n < 19471033) \times = 1, y = 2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               const mod one = mod(1), mc = mod(c);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    vector<bool> is_prime(n + 1, 1);
                                                             if (n < 1373653) \times = 0, y = 2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           mod y = one; for (ull l = 1; ; l <<= 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            template <class T, class mod>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           y = y * y + mc;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     T g = gcd(n, p.x);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     uint sqrt_n = sqrt(n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             ull brent(ull n, ull c) {
if (n <= 8) return 1;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     vector<ExactDiv> primes;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              auto sy = y;
                              int x = 6, y = 7;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    void init(uint n) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              mod::set_mod(n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        primes.clear();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              mod p = one;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return g;
                                                                                                                                                                                                                                                                                                                                                                    struct ExactDiv {
                                                                                                                                                                                                                                                                                                                                                                                                        ExactDiv() {}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      ×:
                                                                                                                                                                    else if
                                                                                                                                                                                                  else if
                                                                                                                                                                                                                                                                                               static void set_mod(T m) { mod = m, inv = mul_inv(mod), r2 = -dT(mod) % mod; }
                                                                                                      a'.
                                                                                                 Mod r(1); for (Mod a = *this; e; e >>= 1, a *= a) if (e & 1) r *= a
"od operator * (const Mod &rhs) const { return Mod(*this) *= rhs;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           bool is_prime(ull n) { // reference: http://miller-rabin.appspot.com
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             for (j = s - 1; j > 0; —j) { if ((a *= a) == fone) break; }
                                                                                                                                                                                                                                                                                                                                                                 T_{y} = T(x >> wb) - T((dT(T(x) * inv) * mod) >> vb)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                   static T mul_inv(T n, int e = 6, T x = 1) {
    return !e ? x : mul_inv(n, e - 1, x * (2 - x * n));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                325, 9375, 28178, 450775, 9780504, 1795265022}
                                                                                                                                                                                                                                    static T modulus() { return mod; }
static T init(T w) { return reduce(dT(w) * r2); }
                                 Mod operator - () const { return Mod() - *this; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              2570940, 880937, 610386380, 4130785767u}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       bool composite(T n, const uint* bases, int m) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                {2, 2570940, 211991001, 3749873356u},
{2, 2570940, 880937, 610386380, 41307
{2, 325, 9375, 28178, 450775, 9780504
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if (a == one || a == fone) continue;
                                                                                                                                                                                                  get() const { return reduce(x); }
                                                                                                                                                                                                                                                                                                                                                                                                return ST(y) < 0 ? y + mod : y;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       using Mod64 = Mod<ull, uint128, ll>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          mod one(1), fone(n - 1); for (int i = 0, j; i < m; ++i) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 static const uint bases[][7] = {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 {15, 176006322, 4221622697u},
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               mod a = mod(bases[i]).pow(d)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        using Mod32 = Mod<uint, ull, int>;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int s = \_builtin\_ctzll(n-1);
T d = (n-1) >> s;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           template <> uint Mod32::mod = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          template <> uint Mod32::inv = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       template <> ull Mod64::mod = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   template \Rightarrow ull Mod64::inv = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 };
if (n <= 1) return 0;
if (!(n & 1)) return n == 2;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           template \Rightarrow uint Mod32::r2 = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    template <> ull Mod64::r2 = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             assert(n < (ull(1) << 63));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      template <class T, class mod>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if (j == 0) return 1;
                                                             Mod pow(ull e) const {
                                                                                                                                                                                                                                                                                                                                  static T reduce(dT \times)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              mod :: set_mod(n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               {2, 3},
{2, 299417},
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             [2, 7, 61],
                                                                                                                                     return r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 return 0;
```

```
for (int s = 0, u = sum; s <= k - r; ++s, u = mul(u, 1)) add(cur, mul(u, cof
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    rep(r, 0, k-s+1) add(cof[r + o * i][s - i], mul(v, tmp[r][s]));
                                                                                                                                                                                                                       rep(j, 1, i+1) C[i][j] = (C[i-1][j] + C[i-1][j-1]) % P;
                                                                                                                           2, K+2) inv[i] = mul(P - P / i, inv[P % i]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     rep(s, 0, k-r) add(cof[s][r + 1 - i], mul(u, tmp[r][s]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if (k1 == 0) { res = 1; rep(i, 0, k2) res = mul(res, b / c); } rep(i, 0, k) memset(cof[i]+1, 0, 4 * (k-i));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          rep(r, 0, k-s+1) add(tmp[r][s-i], mul(u, cof[r][s]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       int cur = 0, x = reduce(a, c), y = (reduce(b, c) + P) % P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               for (int i = 1, u = n; i <= r + 1; ++i, u = mul(u, n))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          add(sum, mul(u, mul(C[r+1][i], B[r+1-i])));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        rep(i, 0, k) memcpy(tmp[i]+1, cof[i]+1, 4 * (k - i));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        for (int i = 1, u = x; i <= k; ++i, u = mul(u, x))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   int u = mul(c[r+1][i], mul(B[i], inv[r+1]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            rep(i, 0, k) memset(cof[i]+1, 0, 4 * (k-i));
rep(r, 0, k) rep(i, 0, r+1) {
                                                                                                                                                                                                                                                                                                                                                  rep(j, 0, i) add(sum, mul(C[i + 1][j], B[j]));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int run(int n, int a, int b, int c, int k1, int k2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              \mathsf{rep}(i, 0, k) \; \mathsf{memset}(\mathsf{tmp[i]}, 0, 4 * (k-i));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(s, 1, k+1) rep(i, 1, s+1) { int u = mul(C[s][1], i \& 1?1:P-1);
                                                                                                                                                                                                                                                                                                                                                                             B[i] = (1 + mul(P - sum, inv[i + 1])) \% P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 sum = mul(sum, inv[r + 1]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   int 1 = ((11)a * n + b) / c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                      inline void calc(int x, bool 0) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    int v = mul(C[s][i], u);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               add(res, mul(sign, cur));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    calc(x, 1); calc(y, 0);
    < 0) a += b,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int res = 0, sign = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      n = 1; swap(a, c);
                                                                                       void init() {
  inv[1] = 1; rep(i, 2
  rep(i, 0, K+2) {
    C[1][0] = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     cof[r][0] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(r, 0, k+1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          rep(s, i, k+1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int sum = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if (!a) break;
                                                                                                                                                                                                                                                                                   rep(i, 0, K+1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      cof[k1][k2] = 1;
                                                                                                                                                                                                                                                                                                                   int sum = 0;
    if ((a %= b)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          k = k1 + k2;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     while (1) {
                                    return res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  //\Sum_{X = 0} ^ {n} x ^ {k_1} {\left \lfloor \frac{ax + b}{c} \cdot \right \rfloor} ^ {k_2}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               static const int K = 10, P = 998244353; // e1+e2 <= K int inv[K + 2], C[K + 2][K + 2], B[K + 1]; // \dot{U}_{DDDD}^{2}® int cof[K + 1][K + 1], tmp[K + 1][K + 1], K; inline void add(int &a, int b) { if ((a += b) >= P) a -= P; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if (n > 1) ret.emplace_back(n, 1);
if (ret.size() - s >= 2) sort(ret.begin() + s, ret.end());
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          inline int mul(int a, int b) { return 111 * a * b % P; }
                                                                                                                                                                                               b = 2;
                                                                                                                                                                                       ull v2 = sqrtl(n), v3 = cbrtl(n), v = v2, if (v2 * v2 == n | | v3 * v3 * v3 == n) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       6++;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                while (n \% p == 0) n /= p, e += 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                while (p.divide(n)) n = n / p,
                                                                                                                                                                                                                                                    if (v2 * v2 != n) v = v3, b = 3;
                                                                                                                                                                                                                                                                                                                     for (auto &&e: ret) e.se *= b;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if (!is_prime(p)) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             while (n > lim && !is_prime(n))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       ull lim = sqr(primes.back().n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             ret.emplace_back(p.n, e);
return brent<ull, Mod64>(n, c);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  ret.emplace_back(p, e);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              uint e = 1; n = n / p;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     for (ull c = 1; ; ++c) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if (sqr(p.n) > n) break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                ret.emplace_back(2, e);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       ull p = brent(n, c);
                                                                                           assert(n < (1ull << 63));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        uint e = 1; n /= p;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int reduce(int &a, int b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       for (auto &&p: primes) {
                                                                 vector<pli>rectors(ull n)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              扩展类欧几里得
                                                                                                                           if (n <= 1) return {};</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if (p.divide(n)) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             uint s = ret.size();
                                                                                                                                                                                                                                                                                        ret = factors(v);
                                                                                                                                                                                                                                                                                                                                                                                                                                              uint e = ctz(n);
                                                                                                                                                          vector<pli>ret;
                                                                                                                                                                                                                                                                                                                                                                                                            if (!(n & 1)) {
                                                                                                                                                                                                                                                                                                                                                       return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  oreak;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             n >>= e;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          return ret;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         namespace _lo {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 11.17
```

```
for(int _ = mi == 1 ? j + 1 : j - 2; ; mi == 1 ? ++_ : --_) { int c = x >> t[_] & 7;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            hm[o].upd(x | (1 << t[j-1]) | (2 << t[j]), y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             hm[o].upd(x \land (k << t[j-1]) \land (k << t[j]), y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          else if(p == 2 && q == 1 || p == q && p >= 3) {
                                                                                                                                                                                                                                                                                                                                for(int i = hd[p]; \sim i; i = ne[i]) if(u == s[i]) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                 s[\Gamma] = n; f[\Gamma] = v; ne[\Gamma] = hd[p]; hd[p] = \Gamma++;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              rep(k, 0, hm[o ^ 1].L) { int x = hm[o ^ 1].f[k] + 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if(x >> t[m + 1] || y <= 0) continue;
int p = x >> t[j - 1] & 7, q = x >> t[j] & 7;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int tx = x \wedge (p < t[j-1]) \wedge (q < t[j]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           rep(i, 1, n + 1) {
    rep(k, 0, hm[o].L) {
    if(hm[o].s[k] >> t[m]) hm[o].f[k] = -1;
                                                               static const int INF = pw(18) - 1, N = 8e5;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int mi = min(p, q), now = 1, nx = tx;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int o = 0; hm[o].init(); hm[o].upd(0, 0);
                                                                                             int hd[INF + 1], ne[N], s[N], L, f[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if(ip \&\& iq) hm[o].upd(x, y-1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              else if(p == 1 && q == 2)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           else if(min(p, q) <= 2) {
                                                                                                                                                                    memset(hd, -1, sizeof(hd))
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            else\ if(a[i][j] == 0) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                else hm[o].s[k] <<= 3;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               hm[o].upd(x, y - 1);
else if(!p || !q) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if(c == mi) ++now;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           o ^= 1; hm[o].init();
int n, m, a[22][22], t[22];
                                                                                                                                                                                                                                                                 void upd(int u, int v) {
                                                                                                                                                                                                                                                                                                                                                                    f[i] = min(f[i], v);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int k = max(p, q);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           hm[o].upd(tx, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            hm[o].upd(x, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             rep(j, 1, m + 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if(a[i][j] == 1) {
                                                                                                                                                                                                                                                                                                    int p = u & INF;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             if(!p && !q)
                                                                                                                                void init() {
                                                                                                                                                                                                                                                                                                                                                                                                       return ;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   int solve() {
                              struct HM {
                                                                                                                                                                                                       L = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                }hm[2];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             res.g=add(res.g,add(111*(x<<1)*res.h%P,add(111*(y<<1)*res.f%P,add(111*ss(n)*pow(
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           res.g=dec(dec(dec(111*n*MMP*(M+1)MP,res.f),mul(h,2)),mul(f,2));\\
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              inline int ss(R int x) \{ return 111^*x^*(x+1) \%^*((x<<1)+1) \%^*inv6\%P; \}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            \times)%P, add(111*n*(n+1)%P*x%P*y%P,111*(n+1)*pow(y)%P))));
                                                                                                                                                                                                                              // g= \sum \limits_{=\{i=0\}} \sqrt{n} \{n\} \{1|f|loor \slash f|s|+b\} \{c\} \slash f|s| \} // h = \slash \limits_{=\{i=0\}} \sqrt{n} \} // f|s| 
                                                                                                                                                                                                                                                                                                                                                                                                                           inline int dec(R int x, R int y) {return x-y<0?x-y+P:x-y;} inline int mul(R int x, R int y) {return 111*x*y-111*x*y/P*P;}
                                                                                                                                                                                               // f = \sum_{i=0}^{n} |i=0|^{n}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          res.h=add(res.h,add(111*ss(n)*x%P,111*s(n)*y%P));
                                                                                                                                                                                                                                                                                                                                                                                               inline int add(R int x,R int y){return x+y>=P?x+y-P:x+y;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           res.f=add(res.f,add(111*s(n)*x%P,111*(n+1)*\sqrt{8}P));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       res.h=111*inv2*dec(dec(111*M*n%P*(n+1)%P,g),f)%P
                                                                                                                                                                                                                                                                                                                                                              const int P=998244353, inv2=499122177, inv6=166374059,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             inline int pow(R int x){return 111*x*x%P;}
inline int s(R int x){return 111*x*(x+1)%P*inv2%P;}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              for(;y;y>>=1,x=mul(x,x))if(y&1)res=mul(res,x);
       - sign;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             void get(int a, int b, int c, int n){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                res.g=111*pow(y)*(n+1)%P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int h=res.h, g=res.g, f=res.f;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             res.f=dec(111*n*M%P,res.f);
     b = -b - 1; sign = P
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               res.f=111*V*(n+1)%P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 struct node{int f, g, h;}res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            res.h=111*y*s(n)%P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               int ksm(R int x,R int y){
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  get(a%c,b%c,c,n);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                int M=(111*a*n+b)/C;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   get(c,c—b—1,a,M—1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                int x=a/c, y=b/c;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if(a>=c||b>=c){}
                                                                                                                                                                                                                                                                                                                                   #define R register
                                                                      return res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     R int res=1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    return res;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    return;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   return;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                eturn;
```

11.18 插头 dp_两通路

/* * 给定 9 * 9 的棋盘,格子四联通,有两类格子, 1 不能走 0 可以走。要求从 S1 走到 71 ,从 S2 走 */

hm[o].upd(nx^^ ((3 ^ p ^ q) << t[_]), y);

 $if(c == (mi \land 3)) \longrightarrow now;$

if(!now)

break;

```
hm[o].upd(x \land ((p | q) << t[j-1]) \land ((p | q) << t[j]), y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       for(int _{-} = p == 1? j + 1: j - 2; ; p == 1? ++_{-}: —_)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     hm[o].upd(x \mid (1 << t[j-1]) \mid (2 << t[j]), y);
                                                    for(int i = hd[p]; \sim i; i = ne[i]) if(u == s[i]) {
                                                                                                                                                           s[L] = u; f[L] = v; ne[L] = hd[p]; hd[p] = L++;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 1, n + 1) rep(j, 1, m + 1) ok[i][j] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    int p = x >> t[j - 1] & 3, q = x >> t[j] & 3;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int tx = x \wedge (p < t[j - 1]) \wedge (q < t[j]);
11 y = hm[o ^ 1].f[k];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(i, 1, n + 1) {
    rep(j, 0, hm[o].L) hm[o].s[j] <<= t[1];
    rep(j, 1, m + 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        hm[o].upd(nx \land (3 << t[\_]), y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        int o = 0; hm[o].init(); hm[o].upd(0, 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if(s[i][j] == '*') hm[o].upd(x, y);
                                                                                                                                                                                                                                                                per(i, 1, n + 1) per(j, 1, m + 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                   rep(i, 1, n + 1) cin >> (s[i] + 1);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 } else if(p == 1 && q == 2) {
  if(ok[i][j] && !tx) ans += y;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if(s[i][j] == 'x') {
   if(!p && !q) hm[o].upd(x, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        c == p ? ++now : --now;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     int c = x >> t[_] \& 3;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(k, 0, hm[o ^{\wedge} 1].L) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  int x = hm[o ^ 1].s[k];
if(x >> t[m + 1]) continue;
                                                                                                                                                                                                                                                                                                                if(s[\bar{i}][j] == '0') return
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int now = 0, nx = tx;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             o ^{\wedge}= 1; hm[o].init();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        } else if(!p || !q) {
hm[o].upd(x, y);
void upd(int u, 11 v) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              if(!c) continue
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  if(now == -1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   else if(p == q)
                                int p = u \& INF;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if(!p && !q) {
                                                                                                                                                                                                                                                                                          ok[i][j] = 1;
                                                                              f[i] += v;
                                                                                                                                                                                                                                                                                                                                                                                                                             cin >> n >> m;
                                                                                                        return ;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                11 ans = 0;
                                                                                                                                                                                                                                                                                                                                                                                               11 solve() {
                                                                                                                                                                                                                                        void gao() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   } else {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          gao();
                                                                                                                                                                                                               \hm[2];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     * 给定 12 * 12 的棋盘,格子四联通,有三类格子, X 不能走 O 必走 * 可走可不走。画一条回路,求方
                                                                                                                                                                                                                                                                                        for(int _ = ma == 1 ? j + 1 : j - 2; ; ma == 1 ? ++_ : ---) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(i, 0, hm[o].L) if(!hm[o].s[i]) ans = hm[o].f[i] - 2;
                                                                                                                                                                                                                                                                                                                                                                                                                         hm[o].upd(nx \wedge ((3 \wedge ma \wedge kk) << t[\_]), y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     rep(i, 1, n + 1) rep(j, 1, m + 1) cin >> a[i][j];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      static const int INF = pw(18) - 1, N = 8e5; int hd[INF + 1], ne[N], s[N], L; ll f[N];
                                                                              hm[o].upd(x | (kk << t[j-1]), y);
                                                                                                        hm[o].upd(x | (kk << t[j]), y),
else if(!p || !q) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int n, m, edx, edy, t[22], ok[22][22]
                                                                                                                                                                                                                                                                                                                                                                       if(c == (ma \land 3)) \longrightarrow now;
                                                                                                                                                                                                                                                                                                                    int c = x >> t[\_] & 7;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            int main() {
    rep(i, 0, 22) t[i] = i + i + i;
    while(cin >> n >> m) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     memset(hd, -1, sizeof(hd));
                                                                                                                                                                                                                                                                                                                                                if(c == ma) ++now;
                                                                                                                                                                                                                                                                    int now = 1, nx = tx;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            四四四
                                                                                                                                                                                                                                        else if(ma <= 2) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               cout << solve() << endl
                            int kk = a[i][j] + 1;
if(!p && !q) {
                                                                                                                                                             int ma = max(p, q);
if(ma == kk) {
                                                                                                                                                                                                               hm[o].upd(tx, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if(!n && !m) break;
                                                                                                                                                                                                                                                                                                                                                                                                   if(!now) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            插头 dp
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           void init() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    char s[22][22];
struct HM {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int ans = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              return ans;
      } else {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 L = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                11.19
```

```
\label{eq:local_problem} \begin{split} & \text{hm}[o] \ . \text{upd}(x \land ((p \mid q) << t[j] \land ((p \mid q) << t[j]), \ y); \\ & \text{else if}(p == q) \ \end{split}
                                                                                                                                                                                                                                                      void gao(int s) {
  int o = 0; hm[o].init(); hm[o].upd(sta[s] << t[1], 1);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                for(int _ = p == 1 ? j + 1 : j - 2; ; p == 1 ? ++_ : int c = x >> t[_] & 3;
                                                                                                                                                                                                                                                                                                                                                                                                                                           int p = x >> t[j - 1] & 3, q = x >> t[j] & 3;
int tx = x ^ p << t[j - 1] ^ q << t[j];
if(!p && !q) {</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   hm[o].upd(x \mid (1 \le t[j-1]) \mid (2 \le t[j]), y);
                                                                                                                                                                                                                                                                                                                                                                                   int x = hm[o ^ 1].s[k], y = hm[o ^ 1].f[k];
if(x >> t[n + 1]) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               rep(_, 0, hm[o].L) if(!(hm[o].s[_] >> t[n])) {
    int i = id[hm[o].s[_]];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    A.a[i][s] = add(A.a[i][s], hm[o].f[_]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               hm[o].upd(nx \land (3 << t[\_]), y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   } else if(p == 2 && q == 1)
                                                                                                                                                                                                                                                                                                                                                                 rep(k, 0, hm[o \wedge 1].L) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          c == p ? ++now : --now;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                } else if(!p || !q) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(i, 0, n) {
    int c = x >> t[i] & 3;
                                                                                                                                                                                                                                                                                                             rep(j, 1, n + 1) {
 o ^= 1; hm[o].init();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   if(now < 0) return 0;
                      Mat kpow(Mat a, int b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      int now = 0, nx = tx;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(c == 3) return 0;
if(c == 1) ++now;
                                                                                                      a'.
                                                                                                  if(b \& 1) r = r *
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        if(c == 2) -now;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if(!c) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if(now == -1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               hm[o].upd(tx, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              hm[o].upd(x, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              bool check(int x) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         return now == 0;
                                                  Mat r; r.set();
while(b) {
                                                                                                                          a = a * a;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int now = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             break;
                                                                                                                                                        b >>= 1;
                                                                                                                                                                                                          return r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             0, k) rep(t, 0, k) r.a[i][j] += a[i][t] * c.a[t][j];
0, k) r.a[i][j] %= P;
                                                                                                                                                                                                                                                                                                           rep(i, 1, T + 1) cout << "Case " << i << "; " << solve() << endl;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   * 给定 7 * 169 的棋盘,格子四联通,每个格子必走。求左上走到左下的方案数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      11 a[N][N];
mat() { rep(i, 0, k) rep(j, 0, k) a[i][j] = 0; }
void reset() { rep(i, 0, k) rep(j, 0, k) a[i][j] = 0; }
void set() { rep(i, 0, k) a[i][i] = 1; }
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                inline int mul(int a, int b) \{ return 111 * a * b % P; \}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              int n, m, id[20202], t[22], k, dp[2][N]; vi sta;
inline int add(int a, int b) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          inline Mat operator * (const Mat &c) const {
                                                                                                                                                                                                                                                                                                                                                                                                                 矩阵加速通路
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         s[L] = u, f[L] = v; hd[u] = L++;
} else if(p == 2 && q == 1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         inline void upd(int u, int v) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             rep(i, 0, L) hd[s[i]] = -1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      const int P = 7777777, N = 150;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                static const int N = pw(16);
                                                                                                                                                                                                                                int main() {
    rep(i, 0, 22) t[i] = i + i;
    int T; cin >> T;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          int hd[N], s[N], L, f[N];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if((a += b) >= P) a -= P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   f[i] = add(f[i], v);
                        hm[o].upd(tx, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               rep(i, 0, k) rep(j, rep(j, c) k) rep(j, o, k) rep(j, c)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       inline void init() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           int i = hd[u];
                                                                                                                                                                                                                                                                                                                                                                                                                 插头 db
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     if(~hd[u])
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       return r;
                                                                                                                                                                                  return ans;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 } else {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                struct Mat {
                                                                                                                                                                                                                                                                                                                                         return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          struct HM {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                return a;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      Mat r;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           \Gamma = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                   11.20
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    }hm[2];
```

```
for(int _ = k == 1 ? j + 1 : j - 2; ; k == 1 ? ++_ : —_) int c = x >> t[_] & 3;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 For(int \_ = k == 1 ? j + 1 : j - 2; ; k == 1 ? ++\_
                                                                                                                                              rep(k, 0, hm[o \wedge 1].L) {
int x = hm[o \wedge 1].s[k], y = hm[o \wedge 1].f[k] + a[i][j];
                                                                                                                                                                                                                                                                                                                                                                                                                  \begin{split} & \text{hm[o].upd}(x \mid (1 << t[j-1]) \mid (2 << t[j]), \; y); \\ & \text{hm[o].upd}(x \mid (3 << t[j-1]), \; y); \\ & \text{hm[o].upd}(x \mid (3 << t[j]), \; y); \\ & \text{hm[o].upd}(x, \; y-a[i][j]); \end{split}
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   \label{eq:hm[o].upd(x, y);} $$ hm[o].upd(x \wedge (k << t[j-1]) \wedge (k << t[j]), y); $$
                                                                                                                                                                                                                                   int p = x >> t[j - 1] & 3, q = x >> t[j] & 3;
int tx = x ^ (p << t[j - 1]) ^ (q << t[j]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    hm[o].upd(nx \wedge ((3 \wedge p \wedge q) << t[\_]), y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  hm[o].upd(nx \wedge (k << t[\_]), y);
                                                                                                                                                                                                                                                                                                                             if(!p \&\& !q) hm[o].upd(x, y - a[i][j]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          hm[o].upd(tx, y);
else if(min(p, q) <= 2) {
int k = min(p, q), now = 1, nx = tx;</pre>
                           rep(i, 1, n + 1) {
    rep(j, 0, hm[o].L) hm[o].s[j] <<= t[1];
    rep(j, 1, m + 1) {
int o = 0; hm[o].init(); hm[o].upd(0, 0);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            if(!tx) ans = max(ans, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if(c == k) ++now;

if(c == (k \land 3)) \longrightarrow now;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           int c = x >> t[] \& 3;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   } else {
if(!tx) ans = max(ans, y);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   } else if(p == 1 && q == 2)
} else if(p == 2 && q == 1)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           if(c == (k \land 3)) —now;
                                                                                                                                                                                                          if(x >> t[m + 1]) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        int now = 1, nx = tx
                                                                                                                o ^= 1; hm[o].init();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               if(c == k) ++now;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         else if(!p || !q) { int k = max(p, q);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      if(!now) {
                                                                                                                                                                                                                                                                                                 if(a[i][j] == 0) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 if(k == 3) {
                                                                                                                                                                                                                                                                                                                                                                                        if(!p && !q) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    break
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if(!now) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          } else {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    break;
                                                                                                                                                                                                                                                                                                                                                             } else {
```

```
* 给定 7 * 7 的棋盘,格子四联通,格子有收益或不能走。求通路的最大收益。
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                int p = u & INF;
for(int i = hd[p]; ~i; i = ne[i]) if(u == s[i]) {
   f[i] = max(f[i], v);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              s[L] = u; f[L] = v; ne[L] = hd[p]; hd[p] = L++;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     static const int INF = pw(18) - 1, N = 8e5;
                                                                                                                                                                                                                                         int main() {
    rep(i, 0, 22) t[i] = i + i;
    memset(hm[0].hd, -1, sizeof(hm[0].hd));
    memset(hm[1].hd, -1, sizeof(hm[0].hd));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             int hd[INF + 1], ne[N], s[N], L, f[N];
                 rep(i, 0, pw(n << 1)) if(check(i)) {
  id[i] = sz(sta);</pre>
                                                                                                                                                                                                                                                                                                                                                                                                        else cout << "Impossible" << endl;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 rep(i, 1, n + 1) rep(j, 1, m + 1) {
                                                                                                                                                       A = kpow(A, m);
int i = id[1 ^ 2 << t[n - 1]];
                                                                                                                                                                                                                                                                                                                                                                                       if(ans) cout << ans << endl;</pre>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         memset(hd, -1, sizeof(hd));
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      通路
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                ans = max(ans, a[i][j]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           int n, m, t[22], a[22][22];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          void upd(int u, int v) {
                                                                                                          k = sz(sta); A.reset();
rep(j, 0, k) gao(j);
                                                                                                                                                                                                                                                                                                                                        while(cin >> n >> m) {
                                                                                                                                                                                                                                                                                                                                                                int ans = solve();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         int ans = -INT_MAX;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      插头 db_
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      cin >> a[i][j];
                                                                                                                                                                                                   return A.a[i][0];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                cin >> n >> m;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  void init() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      return ;
sta.clear();
                                                                  sta.pb(i);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 int solve() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              Struct HM {
                                                                                                                                                                                                                                                                                                                                                                                                                                                         return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   L = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        11.21
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            }hm[2];
```

int solve() {
 if((n & 1) && !(m & 1)) return 0;

Ξ

```
for (auto v : f[o][3]) if (sz(v.fi) == 2) ans = add(ans, v.se);
                                                                                                                                                   for (int 1 = 1; 1 <= m - 2; 1 += 2) { // 合并区间
                                                                                    9, 9,
                      .
0
                                                                                                                                                                                                                                                                p = 0
                                                                                                       if (1 == m) (f[o][t | 2][tmp] += v.se) %=
                                                                                    += v.se)
                rep(i, 0, sz(tmp)) if (tmp[i]+1 > k) if (!p) continue;
                                                                                                                                                                                                                                            p = 1;
rep(i, 0, sz(tmp)) if (tmp[i]+1 > k)
if (!p) continue;
                                                             (f[o][t][tmp] += v.se) %= P;
if (1 == 0) (f[o][t | 1][tmp]
                                                                                                                                                                                                                                                                                                          (f[o][t][tmp] += v.se) \% = P;
                                                                                                                                                                                                                rep(j, 1+2, m) tmp.pb(a[j]);
                                                                                                                                                                                          rep(j, 0, 1) tmp.pb(a[j]);
                                                                                                                                                                           vi tmp;
= 1;
                                                                                                                                                                                                                                                                                                                                                                                                                       ans = 0;
```

return ans;

return 0;

11.22

```
void solve2() {
    rep(j, 1, S+1) way[0][j] = 1;
    rep(i, 1, S+1) rep(j, 1, S+1) {
    if ((j & i) || lb(j) > lb(i)) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              c[i] = sub(pw2[e[i][i] / 2], dc[i]);
                                                                                                                                                          int n, k, a[N], b[N], ok, p, ans, c[200], ans2, S, m; bool o; map<vi, int> f[2][4];
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             (f[o][t][tmp] += v.se) %= P;

if (1 == 0) (f[o][t | 1][tmp] += v.se) %= P;

if (1 == m - 1) (f[o][t | 2][tmp] += v.se) %= P;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            rep(j, 0, 1) tmp.pb(a[j]); tmp.pb(0); tmp.pb(0);
rep(j, l, m) tmp.pb(a[j]);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             .,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         rep(i, 0, sz(tmp)) if (tmp[i]+1 > k) p =
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        for (int 1 = 0; 1 <= m; 1 += 2) { // 新开区 if (1 == 0 && (t & 1)) continue; if (1 == m && (t & 2)) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          if (1 == m - 1 && (t & 2)) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                if (1 == m - 1 \& (t \& 2)) continue,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               m = sz(v.fi); vi a = v.fi;
rep(1, 0, m) {
if (1 == 0 && (t & 1)) continue;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         if (1 == 0 && (t & 1)) continue;
                                                                                                                                                                                                                                                                                                                                                       rep(i, 0, 2) rep(j, 0, 4) f[i][j].clear();
f[0][o][vi()] = 1; o = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           vi tmp = a; tmp[1] = 0; p = 1;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                rep(1, 0, m) { // 放左或右
                                                                                                                                                                                                                                                                                                                                                                                                                                                                 rep(t, 0, 4) f[0][t].clear();
rep(t, 0, 4) {
// 求相邻差值小于等于 k(k<=4) 的排列数量
// 一种枚举排列的方法
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      for (auto v : f[!0][t]) {
                                                                               #pragma GCC target("sse2")
#pragma GCC optimize("unroll-loops")
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    if (!p) continue;
                                                    #pragma GCC optimize("Ofast")
                                                                                                                                                                                                                                                                         cout << 1 << endl;
                                                                                                                                                                                                                     while (cin >> n >> k) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              a[1]++;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         vi tmp;
                                                                                                                                                                                                                                                                                                                                                                                                             rep(i, 1, n+1) {
                                                                                                                                                                                                                                          if (n == 1) {
                                                                                                                                                                                                                                                                                                       continue;
                                                                                                                                          const int N = 10;
                                                                                                                                                                                                                                                                                                                                                                                                                                            0^{-1}
                                                                                                                                                                                              int main()
```

```
for (int msk = (i - 1) & i; msk >= 0; msk = (msk - 1) & i) {
   if (msk & lb(i)) dc[i] = add(dc[i], mul(c[msk], pw2[e[i ^ msk][i ^ msk] / 2]));
   if (msk == 0) break;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                \inf n, S, e[N][N], way[N][N], a[100], t, x, y, dc[N], c[N], c2[N], c1[N], pw2[500], T,
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          S = pw(n) - 1;
rep(i, 0, S+1) rep(j, 0, S+1) {
    e[i][j] = 0;
    rep(k, 0, n) if (pw(k) & i) e[i][j] += __builtin_popcount(a[k] & j);
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     垃双联通子图计数
                                                                                                                                                                                                                                                                                                                                                                                                                               cout << ans << endl;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            const int N = 1 << 10;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          // c2 边双联通子图个数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  rep(i, 1, S+1) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             // 求边双联通子图个数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       // dc 不联通子图个数
// c1 单联通子图个数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             dc[i] = 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                // c 联通子图个数
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     void solve1() {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  return 0;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         11.23
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               'n',
                                                                                                                                                                        相邻差值小于等于 4 的排列数量
                                                                         while(T--) cout << solve() << endl;</pre>
int main() {
    rep(i, 0, 22) t[i] = i + i;
    int T; cin >> T;
```

```
ror (int mask = i; mask >= 0; mask = (mask - 1) & i) {
   if (mask & ib(i)) way[i][j] = 0;
        if (mask & ib(i)) way[i][j] = add(way[i][j], mul(mul(way[i ^ nsk][j]), c[msk]);
        if (msk == 0) break;
   }

rep(i, 1, S+1) {
        c1[i] = 0;
        for (int msk = (i - 1) & i; msk >= 0; msk = (msk - 1) & i) {
            if (msk & ib(i)) c1[i] = add(c1[i], mul(way[i ^ nsk][msk], c2[msk]));
        if (msk == 0) break;
        }

        if (msk == 0) break;
        if (msk == 0) break;
        if (msk == 0) break;
        }

        if (msk == 0) break;
        if (msk == 0) break;
        }

        if (msk == 0) break;
        if (msk == 0) break;
        if (msk == 0) break;
        }

        if (msk == 0) break;
        if (msk == 0) break;
```