

# Template

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# 1 写在前面

## 1.1 基础模版

```
1 #include <bits/stdc++.h>
2 using namespace std;
3 typedef long long ll;
4 #define OPFI(x) freopen(#x".in", "r", stdin);\
5                 freopen(#x".out", "w", stdout)
6 #define REP(i, a, b) for(int i=(a); i<=(b); ++i)
7 #define REPD(i, a, b) for(int i=(a); i>=(b); --i)
8 inline ll rd(){
9     ll r=0, k=1; char c;
10    while(!isdigit(c=getchar())) if(c=='-') k=-k;
11    while(isdigit(c)) r=r*10+c-'0', c=getchar();
12    return r*k;
13 }
14 int main(){
15     return 0;
16 }
```

## 1.2 vimrc

```
1 syntax on
2 set ts=4 et ai cin sw=4 nu sts=4 sm ru mouse=a title wim=list
3 " im <F1> <esc>:w<CR>
4 im <F5> <esc>:bel ter<CR>
5 " nn <F1> :w<CR>
6 nn <F5> :bel ter<CR>
7
8 im <C-S> <esc>:w<CR>
9 nn <C-S> :w<CR>
10 set mp=gnumake
11 com! Mk sil mak | uns redr! | cw
12 nn <C-M> :Mk<CR>
13
14 " set shell=powershell
15 " set backspace=indent,eol,start
16 " set nocompatible
17 " set sh=powershell bs=indent,eol,start nocp
```

## 2 数据结构

### 2.1 zkw 线段树

单点修区间查

```
1 ll s[N<<2], a[N];
2 int M;
3
4 ll f(ll x, ll y){
5     return x+y; // 改这
6 }
7
8 void build(){
9     for(M=1; M<=n+1; M<=<1);
10    REP(i, 1, n) s[i+M]=a[i];
11    REPD(i, M-1, 1) s[i]=f(s[2*i], s[2*i+1]);
12 }
13
14 ll qrange(int l, int r, ll init){ // 根据 f 传 init
15     ll res=init;
16     for(l=l+M-1, r=r+M+1; l^r^1; l>>=1, r>>=1){
17         if(~l&1) res=f(res, s[l^1]);
18         if(r&1) res=f(res, s[r^1]);
19     }
20     return res;
21 }
22
23 void edit(int x, ll v){
24     for(s[x+=M]=v, x>>=1; x; x>>=1){
25         s[x]=f(s[2*x], s[2*x+1]);
26     }
27 }
28
29 ll qpoint(int x){
30     return s[x+M];
31 }
```

### 2.2 珂朵莉树

```
1 struct node{
2     int l, r;
```

```

3     mutable int v;
4     bool operator<(const node& rhs) const { return l<rhs.l; }
5 };
6
7 set<node> odt;
8 typedef set<node>::iterator iter;
9
10 iter split(ll p){
11     iter tmp=odt.lower_bound((node){p, 0, 0});
12     if(tmp!=odt.end()&&tmp->l==p) return tmp;
13     --tmp;
14     int tl=tmp->l, tr=tmp->r, tv=tmp->v;
15     odt.erase(tmp);
16     odt.insert((node){tl, p-1, tv});
17     return odt.insert((node){p, tr, tv}).first;
18 }
19
20 // 修改和查询注意 split 顺序
21 // iter itr=split(r+1), itl=split(l);

```

## 2.3 FHQ-Treap

以模版文艺平衡树为例

```

1 int n, m, clk, rt;
2 struct node{
3     int key, val, sz, tag, ls, rs;
4 }t[N];
5 int newnode(int k){ return t[++clk]=(node){k, rand(), 1, 0}, clk; }
6 void down(int o){
7     if(t[o].tag){
8         t[t[o].ls].tag=1-t[t[o].ls].tag;
9         t[t[o].rs].tag=1-t[t[o].rs].tag;
10        swap(t[t[o].ls].ls, t[t[o].ls].rs);
11        swap(t[t[o].rs].ls, t[t[o].rs].rs);
12        t[o].tag=0;
13    }
14 }
15 void up(int o){ t[o].sz=t[t[o].ls].sz+t[t[o].rs].sz+1; }
16 void split(int o, int x, int &L, int &R){
17     if(o==0) return L=R=0, void(); down(o);

```

```

18     if(t[t[o].ls].sz+1>=x) R=o, split(t[o].ls, x, L, t[o].ls);
19     else L=o, split(t[o].rs, x-t[t[o].ls].sz-1, t[o].rs, R);
20     up(o);
21 }
22 int merge(int L, int R){
23     if(L==0||R==0) return L+R;
24     if(t[L].val>t[R].val) return down(L), t[L].rs=merge(t[L].rs, R)
        , up(L), L;
25     else return down(R), t[R].ls=merge(L, t[R].ls), up(R), R;
26 }

```

## 3 数学

### 3.1 快速幂

```

1  const ll MOD=998244353; // 改模数
2
3  ll qpow(ll a, ll x){
4      ll res=1;
5      a%=MOD;
6      while(x){
7          if(x&1) res=res*a%MOD;
8          a=a*a%MOD, x>>=1;
9      }
10     return res;
11 }
12
13 ll inv(ll x){ return qpow(x, MOD-2); } // 模数为质数时

```

### 3.2 高斯消元

```

1  const int N=110;
2  ll n;
3  double a[N][N], b[N];
4  void work(){
5      n=rd();
6      REP(i, 1, n){
7          REP(j, 1, n) a[i][j]=rd();
8          b[i]=rd();
9      }

```

```

10     REP(i, 1, n){
11         int t=i;
12         REP(j, i+1, n) if(abs(a[j][i])>1e-7&&(abs(a[t][i])>abs(a[j]
13             ][i])||abs(a[t][i])<1e-7)) t=j;
14         REP(j, i, n) swap(a[t][j], a[i][j]);
15         if(abs(a[i][i])<1e-7){
16             puts("No Solution");
17             return 0;
18         }
19         swap(b[t], b[i]);
20         double e=a[i][i];
21         REP(j, i, n) a[i][j]/=e;
22         b[i]/=e;
23         REP(j, i+1, n){
24             double d=a[j][i];
25             REP(k, i, n) a[j][k]-=d*a[i][k];
26             b[j]-=d*b[i];
27         }
28     }
29     REPd(i, n, 1) REP(j, 1, i-1) b[j]-=a[j][i]*b[i], a[j][i]=0;
30     // REP(i, 1, n) printf("%.2f\n", b[i]);
31     // b[1...n] 保存 Ax=b 的解
32 }

```

## 4 图论

### 4.1 倍增

```

1 void dfs(int x, int fa){
2     pa[x][0]=fa; dep[x]=dep[fa]+1;
3     REP(i, 1, SP) pa[x][i]=pa[pa[x][i-1]][i-1];
4     for(int& v:g[x]) if(v!=fa){
5         dfs(v, x);
6     }
7 }
8
9 int lca(int x, int y){
10     if (dep[x]<dep[y]) swap(x, y);
11     int t=dep[x]-dep[y];
12     REP(i, 0, SP) if(t&(1<<i)) x=pa[x][i];

```

```

13     REPd(i, SP-1, -1){
14         int xx=pa[x][i], yy=pa[y][i];
15         if (xx!=yy) x=xx, y=yy;
16     }
17     return x==y?x:pa[x][0];
18 }

```

## 4.2 网络流

不是我写的，但是看着还好

其中 11 是我改的，不敢保证有没有漏改，但是过了洛谷模版题

### 4.2.1 最大流

```

1  constexpr ll INF = LLONG_MAX / 2;
2
3  struct E {
4      int to; ll cp;
5      E(int to, ll cp): to(to), cp(cp) {}
6  };
7
8  struct Dinic {
9      static const int M = 1E5 * 5;
10     int m, s, t;
11     vector<E> edges;
12     vector<int> G[M];
13     int d[M];
14     int cur[M];
15
16     void init(int n, int s, int t) {
17         this->s = s; this->t = t;
18         for (int i = 0; i <= n; i++) G[i].clear();
19         edges.clear(); m = 0;
20     }
21
22     void addedge(int u, int v, ll cap) {
23         edges.emplace_back(v, cap);
24         edges.emplace_back(u, 0);
25         G[u].push_back(m++);
26         G[v].push_back(m++);
27     }

```

```

28
29 bool BFS() {
30     memset(d, 0, sizeof d);
31     queue<int> Q;
32     Q.push(s); d[s] = 1;
33     while (!Q.empty()) {
34         int x = Q.front(); Q.pop();
35         for (int& i: G[x]) {
36             E &e = edges[i];
37             if (!d[e.to] && e.cp > 0) {
38                 d[e.to] = d[x] + 1;
39                 Q.push(e.to);
40             }
41         }
42     }
43     return d[t];
44 }
45
46 ll DFS(int u, ll cp) {
47     if (u == t || !cp) return cp;
48     ll tmp = cp, f;
49     for (int& i = cur[u]; i < G[u].size(); i++) {
50         E& e = edges[G[u][i]];
51         if (d[u] + 1 == d[e.to]) {
52             f = DFS(e.to, min(cp, e.cp));
53             e.cp -= f;
54             edges[G[u][i] ^ 1].cp += f;
55             cp -= f;
56             if (!cp) break;
57         }
58     }
59     return tmp - cp;
60 }
61
62 ll go() {
63     ll flow = 0;
64     while (BFS()) {
65         memset(cur, 0, sizeof cur);
66         flow += DFS(s, INF);
67     }

```



```

68         return flow;
69     }
70 } DC;

```

#### 4.2.2 费用流

```

1  constexpr ll INF = LLONG_MAX / 2;
2
3  struct E {
4      int from, to; ll cp, v;
5      E() {}
6      E(int f, int t, ll cp, ll v) : from(f), to(t), cp(cp), v(v) {}
7  };
8
9  struct MCMF {
10     static const int M = 1E5 * 5;
11     int n, m, s, t;
12     vector<E> edges;
13     vector<int> G[M];
14     bool inq[M];
15     ll d[M], a[M];
16     int p[M];
17
18     void init(int _n, int _s, int _t) {
19         n = _n; s = _s; t = _t;
20         REP (i, 0, n + 1) G[i].clear();
21         edges.clear(); m = 0;
22     }
23
24     void addedge(int from, int to, ll cap, ll cost) {
25         edges.emplace_back(from, to, cap, cost);
26         edges.emplace_back(to, from, 0, -cost);
27         G[from].push_back(m++);
28         G[to].push_back(m++);
29     }
30
31     bool BellmanFord(ll &flow, ll &cost) {
32         REP (i, 0, n + 1) d[i] = INF;
33         memset(inq, 0, sizeof inq);
34         d[s] = 0, a[s] = INF, inq[s] = true;

```

```

35     queue<int> Q; Q.push(s);
36     while (!Q.empty()) {
37         int u = Q.front(); Q.pop();
38         inq[u] = false;
39         for (int& idx: G[u]) {
40             E &e = edges[idx];
41             if (e.cp && d[e.to] > d[u] + e.v) {
42                 d[e.to] = d[u] + e.v;
43                 p[e.to] = idx;
44                 a[e.to] = min(a[u], e.cp);
45                 if (!inq[e.to]) {
46                     Q.push(e.to);
47                     inq[e.to] = true;
48                 }
49             }
50         }
51     }
52     if (d[t] == INF) return false;
53     flow += a[t];
54     cost += a[t] * d[t];
55     int u = t;
56     while (u != s) {
57         edges[p[u]].cp -= a[t];
58         edges[p[u] ^ 1].cp += a[t];
59         u = edges[p[u]].from;
60     }
61     return true;
62 }
63
64 pair<ll, ll> go() {
65     ll flow = 0, cost = 0;
66     while (BellmanFord(flow, cost));
67     return make_pair(flow, cost);
68 }
69 } MM;

```

### 4.3 二分图最大匹配

ps. 建单向图（即只有左部指向右部的边）

```

1 struct MaxMatch {

```

```

2      int n;
3      vector<int> G[N];
4      int vis[N], left[N], clk;
5
6      void init(int n) {
7          this->n = n;
8          REP (i, 0, n + 1) G[i].clear();
9          memset(left, -1, sizeof left);
10         memset(vis, -1, sizeof vis);
11     }
12
13     bool dfs(int u) {
14         for (int v: G[u])
15             if (vis[v] != clk) {
16                 vis[v] = clk;
17                 if (left[v] == -1 || dfs(left[v])) {
18                     left[v] = u;
19                     return true;
20                 }
21             }
22         return false;
23     }
24
25     int match() {
26         int ret = 0;
27         for (clk = 0; clk <= n; ++clk)
28             if (dfs(clk)) ++ret;
29         return ret;
30     }
31 } MM;

```

#### 4.4 Tarjan 强连通分量缩点

```

1      int low[N], dfn[N], clk, B, bl[N];
2      vector<int> bcc[N];
3      void init() { B = clk = 0; memset(dfn, 0, sizeof dfn); }
4      void tarjan(int u) {
5          static int st[N], p;
6          static bool in[N];
7          dfn[u] = low[u] = ++clk;

```

```

8      st[p++] = u; in[u] = true;
9      for (int& v: G[u]) {
10         if (!dfn[v]) {
11             tarjan(v);
12             low[u] = min(low[u], low[v]);
13         } else if (in[v]) low[u] = min(low[u], dfn[v]);
14     }
15     if (dfn[u] == low[u]) {
16         ++B;
17         while (1) {
18             int x = st[--p]; in[x] = false;
19             bl[x] = B; bcc[B].push_back(x);
20             if (x == u) break;
21         }
22     }
23 }

```