Team Reference
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Contents

1. Estructura de Datos

1.1. Arbol Binario Indexado.

```
# include <cstdio>
 using namespace std;

 int tm, op, p;
 typedef long long ll;

 struct date{
   int save[10005];

   void update(int p, ll v){
      for(int i = p; i <= tm; i += i& -i)
         save[i] += v;
   }

   ll query(int p){
      int sum=0;
      for(int i = p; i > 0; i -= (i & -i))
         sum += save[i];
      return sum;
   }
}bit;

int main(){

  scanf("%d", &tm);
  while(1){

     scanf("%d %d", &op, &p);

     if(op == -1)
        return 0;

     if(op)
        bit.update(p);
     else
        bit.print(p);
  }

}
```

1.2. Segment Tree.

```
# include <iostream>
 # include <algorithm>
 # define oo 1 << 29
 # define RANG 30000000
 using namespace std;

 char c;
 int r1, r2, r3, i, Q;

 struct S_Tree{
   int n;
   int elements[5005];
   int T[RANG], Mk[RANG];

   int Build(int x, int xend, int P = 1){

      if(x == xend)
         return T[P] = elements[x];

      int pv = (x+xend)/2;
      return T[P] = Build(x, pv, P*2) + Build(pv+1, xend, P*2+1);
   }

   void Lazy_propagation(int x, int xend, int P){
      if(x == xend)
         return;

      int pv = (x+xend)/2;

      T[P*2] += (pv - x + 1)* Mk[P];
      T[P*2+1] += (xend - pv )* Mk[P];

      Mk[P*2] += Mk[P];
      Mk[P*2+1] += Mk[P];

      Mk[P] = 0;
```

```
   }

   int Query(int x, int xend, int P = 1){

      if(r2 < x || xend < r1)
         return 0;

      if(Mk[P])
         Lazy_propagation(x, xend, P);

      if(r1 <= x && xend <= r2)
         return T[P];

      int pv = (x+xend)/2;
      return Query(x, pv, P*2) + Query(pv+1, xend, P*2+1);
   }

   int Update(int x, int xend, int P = 1){

      if(Mk[P])
         Lazy_propagation(x, xend, P);

      if(r2 < x || xend < r1)
         return T[P];

      if(r1 <= x && xend <= r2){
         Mk[P] += r3;
         T[P] += ((xend-x)+1)*r3;
         return T[P];
      }

      int pv = (x+xend)/2;
      return T[P] = Update(x, pv, P*2) + Update(pv+1, xend, P*2+1);
   }
}St;

int main(){
   cin >> St.n;
   for(i = 1; i <= St.n; i++)
      cin >> St.elements[i];
  St.Build(1, St.n);
   cin >> Q;
   while(Q--){
      cin >> c >> r1 >> r2;
      if(c == 'Q')
         cout << St.Query(1, St.n) << endl;
      else{
         cin >> r3;
         St.Update(1, St.n);
      }
   }

return 0; }
```

1.3. **Range Min-Max Quering.**

```
# include <cstdio>
 # include <cmath>
 # include <algorithm>
 using namespace std;

 int mat[5005][20];
 int n, p2, p1, q;

 void Build_RMQ(){

   int cc = (int) log2(n);
   int p = n, a, i, j;
   for(i = 1; i <= cc; i++){
      a = 1 << (i-1);
      p -= a;
      for(j = 1; j <= p; j++)
         mat[j][i] = min(mat[j][i-1], mat[j+a][i-1]);
   }
}

void find_RMQ(){
     int c = (int)log2(p2-p1);
     printf("%d\n", min(mat[p1][c], mat[p2-(1<<c)+1][c]));
}

int main(){


   scanf("%d %d", &n, &q);
   for(int i = 1; i <= n; i++)
      scanf("%d", &mat[i][0]);
```

```
   Build_RMQ();

   while(q--){
      scanf("%d %d", &p1, &p2);
      find_RMQ();
   }

 return 0;
}
```

1.4. Lowest Comon Antecesor.

```
# include <bits/stdc++.h>
 # define RANG 1000005
 using namespace std;

 int i, cn, q, x, y;
 vector <int> v[RANG];

 struct LCA {
   int T[100005][20], L[100005];

   void DFS(int np, int prev){
      L[np] = L[prev]+1;
      int l = v[np].size();
      for(int i = 0; i < l; i++){
         int nh = v[np][i];
         if(nh != prev)
            DFS(nh, np);
      }
    }

   void BFS(int np){
      queue <int> Q;
      Q.push(np);
      L[np] = 1;
      int l, nh;
      while(!Q.empty()){
         np = Q.front();
         Q.pop();

         l = v[np].size();
         for(int i = 0; i < l; i++){
            nh = v[np][i];
            if(L[nh] == 0){
               L[nh] = L[np]+1;
               Q.push(nh);
            }
         }
      }

   }

   void Build(int n){
      BFS(1);
      int lg = log2(n);
      for(int j = 1; j <= lg; j++)
         for(int i = 1; i <= n; i++)
            if(T[i][j-1] != -1)
               T[i][j] = T[T[i][j-1]][j-1];
   }

    int Query(int x, int y){
      int sol = 0;
      if(L[x] < L[y])swap(x, y);

      int lg = (int)log2(L[x]);
      for(int i = lg; i >= 0; i--)
         if(L[x] - (1 << i) >= L[y] && T[x][i])
            x = T[x][i], sol += (1 << i);

      if(x == y)return sol;

      for(int i = lg; i >= 0; i--)
         if(T[x][i] != T[y][i] && T[x][i])
            x = T[x][i], y = T[y][i], sol += (1 << i);

      return sol+2;
      return T[x][0];
    }
}Lc;

int main(){

   scanf("%d", &cn);
   for(i = 2; i <= cn; i++){//Leyendo padre
      scanf("%d", &Lc.T[i][0]);
      v[Lc.T[i][0]].push_back(i);
   }
```

```
   Lc.Build(cn);
   scanf("%d", &q);
   while(q--){
      scanf("%d %d", &x, &y);
      printf("%d\n", Lc.Query(x, y));
   }
```

1.5. Heavy Ligth Descomposition+Segmente Tree+Lowest Common Antecesor.

```
# include <bits/stdc++.h>
using namespace std;
typedef pair<int, int> par;

vector <par> v[10005];
vector <int> indx[10005];
int subsize[10005], chainHead[10005], chainIndx[10005];
int posInBase[10005], otherEnd[10005], chainNo, cont;

St -> estructura segment tree. Build-Query-Update+Lazy Propagation
LC -> Lowest Common Antecesor. Level[n], T[n][log n]. Build-Query
//Inicializar Level y subsize
 void DFS(int np, int prev, int depth = 0){
   Lc.Level[np] = depth;
   Lc.T[np][0] = prev;
   subsize[np] = 1;
   int l = v[np].size();
   for(int i = 0; i < l; i++){
      int nh = v[np][i].first;
      if(nh != prev){
         otherEnd[indx[np][i]] = nh;
         DFS(nh, np, depth+1);
         subsize[np] += subsize[nh];
      }
   }
 }
//Descomposition Hevy Ligth
 void HDL(int np, int nc, int prev){
   if(chainHead[chainNo] == -1)
      chainHead[chainNo] = np;

   chainIndx[np] = chainNo;
   posInBase[np] = cont;
Posicion que sera usada en el Segment Tree
   St.elements[cont++] = nc;

   int nh = -1, newc, l = v[np].size();
   for(int i = 0; i < l; i++){
      if(v[np][i].first == prev)continue;
      if(nh == -1 || subsize[nh] < subsize[v[np][i].first]){
         nh = v[np][i].first;
         newc = v[np][i].second;
      }
   }
   if(nh != -1)
      HDL(nh, newc, np);

   for(int i = 0; i < l; i++)
      if(nh != v[np][i].first && v[np][i].first != prev){
         chainNo++;
         HDL(v[np][i].first, v[np][i].second, np);
      }

}
 int query_up(int u, int v){
   int uchain = chainIndx[u], vchain = chainIndx[v], ans = -1;

   while(uchain != vchain){
      ans = max(ans, St.query(0, cont-1, 1, posInBase[chainHead[uchain]],
                              posInBase[u]));
      u = Lc.T[chainHead[uchain]][0];
      uchain = chainIndx[u];
   }

   ans = max(ans, St.query(0, cont-1, 1, posInBase[v]+1, posInBase[u]));

   return ans;
}
int query(int x, int y){
   int lca = Lc.Query(x, y);
   return max(query_up(x, lca), query_up(y, lca));
}
void update(int i, int val){
   int x = otherEnd[i];
   x = posInBase[x];
   St.elements[x] = val;
   St.update(0, cont-1, 1, x);
}
```

```
int n, i, a, b, c, tc;
char arr[50];

int main(){
     scanf("%d", &n);
     cont = 0;
     for(i = 1; i < n; i++){
        scanf("%d %d %d", &a, &b, &c);
        v[a].push_back((par){b, c});
        v[b].push_back((par){a, c});
        indx[a].push_back(i);
        indx[b].push_back(i);
     }

     fill(chainHead, chainHead+10002, -1);
     chainNo = 0;
     DFS(1, -1);
     HDL(1, -1, -1);
     St.Build(0, cont-1);
     Lc.Build(n);
}
```

1.6. Centroid Descomposition+Lowest Common Antecesor.

```
# include <bits/stdc++.h>
using namespace std;

const int oo = 1 << 30;
int subsize[100005], Ant[100005], sol[100005], ref_pos, n, x, y;
vector <int> v[100005];
bool mk[100005];

void DFS1(int np, int prev){
  subsize[np] = 1;
  int l = v[np].size();
  for(int i = 0; i < l; i++){
     int nh = v[np][i];
     if(nh != prev && !mk[nh]){
        DFS1(nh, np);
        subsize[np] += subsize[nh];
     }
  }
}

int DFS2(int np, int prev){

   int l = v[np].size();
   for(int i = 0; i < l; i++){
     int nh = v[np][i];
     if(nh != prev && !mk[nh] && subsize[nh] > subsize[ref_pos]/2)
        return DFS2(nh, np);
   }
   return np;
}

void Descomposition(int root, int prev){
  ref_pos = root;
  DFS1(root, root);
  int centroid = DFS2(root, root);
  Ant[centroid] = prev;
  mk[centroid] = true;
  int l = v[centroid].size();
  for(int i = 0; i < l; i++){
     int nh = v[centroid][i];
     if(!mk[nh])
        Descomposition(nh, centroid);
  }
}
// LC -> tipo LCA, buscar implementacion arriba.

void Update(int x){
  int y = x;
  while(y > 0){
     sol[y] = min(sol[y], Lc.Query(x, y));
     y = Ant[y];
  }
}

int Query(int x){
  int y = x, ans = oo;
  while(y > 0){
     ans = min(ans, Lc.Query(y, x)+sol[y]);
     y = Ant[y];
  }
  return ans;
}
int Q;
```

```
int main(){

  scanf("%d %d", &n, &Q);
  for(int i = 1; i < n; i++){
     scanf("%d %d", &x, &y);
     v[x].push_back(y);
     v[y].push_back(x);
  }

  fill(sol, sol+n+1, oo);
  Lc.Build(n);
  Descomposition(1, -1);
  Update(1);

  while(Q--){
     scanf("%d %d", &x, &y);
     if(x == 1)
        Update(y);
     else
        printf("%d\n", Query(y));

  }
return 0;
}
```

1.7. **Trie.**

```
# include <cstdio>
# include <cstring>
using namespace std;

int n, q, i, j, ls, sol;
char s[505];

struct Trie{
  Trie *son[255];
  int end;
}T, *p = &T;

int main(){

  scanf("%d", &n);
  for(i = 1; i <= n; i++){
     scanf("%s", &s);
     ls = strlen(s);
     p = &T;
     for(j = 0; j < ls; j++){
        if(p -> son[s[j]] == NULL)
           p -> son[s[j]] = new Trie();
        p = p -> son[s[j]];
     }
  }


scanf("%d", &q);
  for(i = 1; i <= q; i++){
     scanf("%s", &s);
     ls = strlen(s);
     p = &T;
     for(j = 0; j < ls; j++){
        if(p -> son[s[j]] == NULL)
           break;
        p = p -> son[s[j]];
        if(j == ls-1)
           sol++;
     }
  }

  printf("%d", sol);
return 0;
}
```

2. Grafos & Flow

2.1. **Articulations Points.**

```
# include <cstdio>
# include <vector>
# include <algorithm>
using namespace std;
```

```
vector <int> v[505];
int low[505], D[505], x, y, cn, cc, l;
bool mk[505];

void Apoint(int node){
low[node] = D[node] = ++l;
int ls = v[node].size();
for(int i = 0; i < ls; i++){
      int next = v[node][i];
      if(!low[next]){
            Apoint(next);
            low[node] = min(low[node], low[next]);
            if( (D[node] == 1 && D[next] > 2) ||
                  (low[next] >= D[node] && D[node] != 1) )
                  mk[node] = true;
      }
      else
            low[node] = min(low[node], D[next]);
}
}
int main(){

scanf("%d %d", &cn, &cc);
for(int i = 1; i <= cc; i++){
      scanf("%d %d", &x, &y);
      v[x].push_back(y);
      v[y].push_back(x);
}

Apoint(1);

for(int i = 1; i <= cn; i++)
      if(mk[i])
            printf("%d\n", i);
}
```

2.2. Brigdes.

```
# include <vector>
# include <cstdio>
# define RANG 5005

using namespace std;

struct par{
      int np, nh;
      bool mk;

      int next(int x){
            if(x == np)
                  return nh;
            return np;
      }
}A[RANG];

int cc, i, L, x, y;
int Low[RANG], T[RANG];
vector <int> v[RANG];

void Brigdes(int np){
T[np] = Low[np] = ++L;
int l = v[np].size();

for(int i = 0; i < l; i++){
      int nh = A[ v[np][i] ].next(np);

      if(!T[nh]){
            A[ v[np][i] ].mk = true;
            Brigdes(nh);
            Low[np] = min(Low[nh], Low[np]);
            if(Low[nh] > T[np])
                  printf("%d %d\n", np, nh);
      }
      else
            if(!A[v[np][i]].mk)
                  Low[np] = min(Low[np], T[nh]);

}
}

int main(){

      scanf("%d", &cc);
      for(i = 1; i <= cc; i++){
            scanf("%d %d", &x, &y);
            A[i] = (par){x, y};
            v[x].push_back(i);
            v[y].push_back(i);
```

```
      }

      Brigdes(1);
```

2.3. Strong Connect Component.

```
# include <stack>
# include <vector>
# include <cstdio>
# include <algorithm>
using namespace std;

int T[5005], low[5005], L;
int x, y, cn, cc;
vector <int> v[5005];
stack <int> S;
bool mk[5005];

void SCC(int np){
      T[np] = low[np] = ++L;
      int l = v[np].size();
      S.push(np);
      for(int i = 0; i < l; i++){
            int nh = v[np][i];
            if(!T[nh]){
                  SCC(nh);
                  low[np] = min(low[nh], low[np]);
            }
            else
                  if(!mk[nh])
                        low[np] = min(T[nh], low[np]);
      }
      if(low[np] == T[np]){
            while(S.top() != np){
                  printf("%d ", S.top());
                  mk[S.top()] = true;
                  S.pop();
            }
            printf("%d\n", S.top());
            mk[S.top()] = true;
            S.pop();
      }
}

int main(){

      scanf("%d %d", &cn, &cc);
      for(int i = 1; i <= cc; i++){
            scanf("%d %d", &x, &y);
            v[x].push_back(y);
      }

      for(int i = 1; i <= cn; i++)
            if(!mk[i])
                  SCC(i);
      return 0;
}
```

2.4. Kruskal.

```
# include <queue>
# include <cstdio>
using namespace std;

int R[5005], Set[5005];
int i, x, y, z, n1, n2, sol, cn, cc;

struct par{
      int x, y, z;
      bool operator < (const par &a)
      const {
            return z > a.z;
      }
};

priority_queue <par> Q;

void make_set(){
      for(int i = 1; i <= cn; i++)
            R[i] = 1, Set[i] = i;
```

```
}

int find_set(int x){
      if(x != Set[x])
            return Set[x] = find_set(Set[x]);
      return x;
}

void join_set(){
      if(R[n1] > R[n2])
            Set[n2] = n1, R[n1] += R[n2];
      else
            Set[n1] = n2, R[n2] += R[n1];
}

int main(){

      freopen("kruskal.in", "r", stdin);
      freopen("kruskal.out", "w", stdout);

      scanf("%d␣%d", &cn, &cc);
      for(i = 1; i <= cc; i++){
            scanf("%d␣%d␣%d", &x, &y, &z);
            Q.push((par){x, y, z});
      }

      make_set();
      for(; !Q.empty(); Q.pop()){
            n1 = find_set(Q.top().x);
            n2 = find_set(Q.top().y);
            if(n1 != n2)
                  sol += Q.top().z,
                  join_set();
      }

      printf("%d", sol);

      return 0;
}
```

2.5. Prim.

```
# include <queue>
# include <vector>
# include <cstdio>
using namespace std;

struct par {
      int n1, n2;
      bool operator < (const par &a)
      const {
            return n2 > a.n2;
      }
};

bool mk[5005];
int np, nh, nc, ch, i, l, x, y, z, sol, cn, cc;
vector <par> v[5005];
priority_queue <par> Q;

int main(){

      scanf("%d␣%d", &cn, &cc);

      for(i = 1; i <= cc; i++){
            scanf("%d␣%d␣%d", &x, &y, &z);
            v[x].push_back((par){y, z});
            v[y].push_back((par){x, z});
      }

      for(Q.push((par){1, 0});
            !Q.empty();
            Q.pop()){

            np = Q.top().n1;
            nc = Q.top().n2;
            l = v[np].size();

            if(mk[np])continue;
            mk[np] = true;
            sol += nc;

            for(i = 0; i < l; i++){
                  nh = v[np][i].n1;
                  ch = v[np][i].n2;
                  if(!mk[nh])
                        Q.push((par){nh, ch});
            }
```

```
      }

      printf("%d", sol);
```

2.6. K-th Camino Mínimo.

```
# include <queue>
# include <vector>
# include <cstdio>
# define RANG 5005
using namespace std;

struct par {
      int x, y;
      bool operator > (const par &a)
      const {
            return y > a.y;
      }
};

vector <par> v[RANG];
priority_queue <par, vector<par>, greater<par> > Q;
int End, cc, i, x, y, z, np, nh, nc, hc, l, k;
int V[RANG];

int k_th(){

      for(Q.push((par){1, 0}); !Q.empty(); ){
            np = Q.top().x;
            nc = Q.top().y;
            Q.pop();
            l = v[np].size();
            V[np]++;
            if(np == End){
                  if(V[np] == k)return nc;
            }

            for(i = 0 ; i < l; i++){
                  nh = v[np][i].x;
                  hc = v[np][i].y;
                  if(V[nh] < k)
                        Q.push((par){nh, nc+hc});
            }
      }
}

int main(){

      scanf("%d %d %d", &cc, &End, &k);
      for(i = 1; i <= cc; i++){
            scanf("%d %d %d", &x, &y, &z);
            v[x].push_back((par){y, z});
            v[y].push_back((par){x, z});
      }

      printf("%d", k_th());

      return 0;
}
```

2.7. Floyd Warshall.

```
# include <cstdio>
using namespace std;

int cn, cc, i, j, k, x, y, z;
int map[305][305];

int main(){

      scanf("%d %d", &cn, &cc);

      for(i = 1; i <= cc; i++){
            scanf("%d %d %d", &x, &y, &z);
            if(map[x][y] == 0 || map[x][y] > z)
                  map[x][y] = z;
            if(map[y][x] == 0 || map[y][x] > z)
                  map[y][x] = z;
      }

      for(k = 1; k <= cn; k++)
            return 0;
}
```

```
      for(i = 1; i <= cn; i++)
            if(map[i][k] > 0){
              for(j = 1; j <= cn; j++){
                    if(map[k][j] == 0)
                          continue;
                    if(map[i][j] == 0 || map[i][j] > map[i][k]+map[k][j])
                          map[i][j] = map[i][k]+map[k][j];
                }
                }
```

2.8. **Camino Circuito Eureliano.**

```
# include <queue>
# include <vector>
# include <cstdio>

using namespace std;

struct tri{
  int np, nh;
  bool mk;

  int next(int x){
     if(x == np)
        return nh;
     return np;
  }
}A[5005];

int ini = 1, i, j, x, y, c, cn, cc, C[5005];
vector <int> v[5005];
queue <int> Q;

void Euler(int np){
   int ls = v[np].size();
   for(int i = 0; i < ls; i++){
      int p = v[np][i];
      if(!A[p].mk){
        A[p].mk = true;
        Euler(A[p].next(np));
      }
  }
  Q.push(np);
}

int main(){
   scanf("%d %d", &cn, &cc);
   for(i = 1; i <= cc; i++){
      scanf("%d %d", &x, &y);
      A[i] = (tri){x, y, false};
      v[x].push_back(i);
      v[y].push_back(i);
      C[x]++;
      C[y]++;
   }

      for(i = 1; i <= cn; i++)
      if(C[i] % 2 == 1)
         c++,
         ini = i;

   if(c > 2){
      printf("No es camino, ni circuito");
      return 0;
   }

   if(c == 2)
      printf("Es camino\n");

   if(c == 0)
      printf("Es circuito\n");

   Euler(ini);

   for(;!Q.empty(); Q.pop())
      printf("%d\n", Q.front());

      return 0;
}
```

```
      for(i = 1; i <= cn; i++){
            for(j = 1; j <= cn; j++)
                  if(map[i][j] == 0)
                        printf("? ");
                  else
                        printf("%d ", map[i][j]);
            printf("\n");
      }
}
```

2.9. **Ford Fulkerson.**

```
# include <queue>
# include <cstdio>
# include <vector>
# include <algorithm>
# define oo 1 << 29

using namespace std;

int sr, sk, n, m, x, y, z, np, nh, cp, p, l, i, max_flow, b;
int Flow[105][105], Fr[105];
bool mk[105];

vector <int> v[105];

int aug_path(){
      priority_queue <pair<int, int> > Q;

      fill(Fr, Fr+n+1, -1);
      fill(mk, mk+n+1, false);
      mk[sr] = true;
      Q.push(make_pair(oo, sr));
      b = 0;

      while(!Q.empty()){
            cp = Q.top().first;
            np = Q.top().second;
            Q.pop();

            if(np == sk){
                        b = max(b, cp);
                  break;
            }

            l = v[np].size();
            for(i = 0; i < l; i++){
                  nh = v[np][i];
                  if(!mk[nh] && Flow[np][nh]){
                        mk[nh] = true;
                        Fr[nh] = np;
                        Q.push(make_pair(min(cp, Flow[np][nh]), nh));
                  }
            }
      }

      nh = sk;
      while(Fr[nh] != -1){
            np = Fr[nh];
            Flow[np][nh] -= b;
            Flow[nh][np] += b;
            v[nh].push_back(np);
            nh = np;
      }

      return b;
}

int main(){

      scanf("%d %d %d %d", &n, &m, &sr, &sk);

      for(i = 1; i <= m; i++){
            scanf("%d %d %d", &x, &y, &z);
            v[x].push_back(y);
            Flow[x][y] = z;
      }

      //while(p = aug_path()) max_flow += p;
      max_flow = aug_path();
      printf("%d\n", max_flow);

      return 0;
}
```

2.10. **Flujo Máximo Costo-Costo Mínimo.**

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

typedef long long ll;

using namespace std;

int n;
```

```
struct nod{
      ll x,y,h;
      int id;
}N[505];

vector<int> v[505];

ll dist(nod a,nod b){
      if(a.id == 0 || b.id == 0 || a.id == n+1 || b.id == n+1)return 0;
      return (b.x - a.x)*(b.x - a.x) + (b.y - a.y)*(b.y - a.y) + (b.h - a.h)*(b.h - a.h);
}

int cap[505][505],tipo[505];
double costo[505][505],res;
vector<int> ady[505];
int from[505];
double d[505];

struct nodo{
      int id,parent;
      double costo;
      bool operator<(const nodo& a)const{
         return costo > a.costo;
      }
};

bool town[505];
double cost[505];
bool visited[505];
bool spring[505];
int s,t,cn;
double valor[505][505];

int augment1(int source, int sink){

      fill(from,from+sink+1,-1);
      fill(d,d+sink+1,99999999.0);
      fill(mk,mk+sink+1,0);

      d[source] = 0;
      bool x = 0;
      bool y = 0;

      for(int i = 1; i <= cn; i++){
            for(int h = 0; h < cn ; h++){
                  int no = tipo[h];
                  int len = v[no].size();
                  for(int k = 0; k < len; k++){
                        int m = v[no][k];
                        if(cap[no][m] && d[m] > d[no] + costo[no][m]){
                              d[m] = d[no] + costo[no][m];
                              from[m] = no;
                              y = 1;
                              if(m == sink)x = 1;
                        }
                  }
            }
            if(!y)break;
      }

      if(!x)return 0;

      int actual = sink;
      res+=d[sink];

      while(from[actual]!=-1){
            cap[actual][from[actual]]++;
            cap[from[actual]][actual]--;
            actual = from[actual];
      }
      return 1;
}

int max_flow(int sink,int source){
      int r = 0;
      while(1){
         if(augment1(sink,source))r++;
         else return r;
      }
}

int main(){

   int a;
   ll q;

   scanf("%d %d %d %I64d",&n,&s,&t,&q);

   N[0].id = 0;
   N[n+1].id = n+1;

   for(int i = 1; i <= n; i++){
      scanf("%I64d %I64d %I64d",&N[i].x,&N[i].y,&N[i].h);
      N[i].id = i;
```

```
      for(int h = 1; h < i; h++){
            // cout<<"d "<<dist(N[i],N[h])<<endl;
               ll g = dist(N[i],N[h]);
               valor[i][h] = valor[h][i] = sqrt((double)g);

         if(g <= q*q && N[i].h > N[h].h){
            ady[i].push_back(h);
         }

         if(g <= q*q && N[i].h < N[h].h){
            ady[h].push_back(i);
         }
      }
   }

   for(int i = 0; i < s; i++){
      scanf("%d",&a);
      tipo[++cn] = a;
      cap[0][a] = 1;
      v[0].push_back(a);
      spring[a] = 1;
   }

   for(int i = 0; i < t; i++){
      scanf("%d",&a);
      cap[a][n+1] = 1;
      v[a].push_back(n+1);
      town[a] = 1;
      tipo[++cn] = a;
   }

   cn++;
   tipo[cn] = n+1;
   for(int i = 1; i <= n; i++){
      if(spring[i]){
         dijkstra(i);
      }
   }

   int k = max_flow(0,n+1);

   if(k < t)printf("IMPOSSIBLE\n");
   else{
      printf("%lf\n",res);
   }

   return 0;
}
```

2.11. **Hungarian Algorithm.**

```
# include<bits/stdc++.h>
using namespace std;

const int MAXN = 105;
const int INF = 1000 * 1000 * 1000;

int n;
int a[MAXN][MAXN];
int u[MAXN], v[MAXN], link[MAXN], par[MAXN], used[MAXN], minval[MAXN];

int main() {

      scanf("%d", &n);
      for (int i = 1; i <= n; i++)
            for (int j = 1; j <= n; j++)
                  scanf("%d", &a[i][j]);

      for (int i = 1; i <= n; i++) {
            for (int j = 0; j < MAXN; j++) {
                  used[j] = false;
                  minval[j] = INF;
            }

            int j_cur = 0;
            par[j_cur] = i;

            do {
                  used[j_cur] = true;
                  int j_next, delta = INF, i_cur = par[j_cur];

                  for (int j = 0; j <= n; j++)
                        if (!used[j]) {
                           int cur = a[i_cur][j] - u[i_cur] - v[j];
                              if (cur < minval[j]) {
                                    minval[j] = cur; link[j] = j_cur;
                              }
                              if (minval[j] < delta) {
                               delta = minval[j]; j_next = j;
```

```
                        }
                }

        for (int j = 0; j <= n; j++)
                if (used[j]) {
                        u[par[j]] += delta; v[j] -= delta;
                }
                else {
                        minval[j] -= delta;
                }
                j_cur = j_next;
} while (par[j_cur]);

                do {
                        int j_prev = link[j_cur];
                        par[j_cur] = par[j_prev];
                        j_cur = j_prev;
                } while (j_cur > 0);
        }

        printf("%d", -v[0]);
        return 0;
}
```