# Programming 3-7: 多源最短路

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### 2018.11.22

# 1 Problem 3-7-A: VIRUS

## 1.1 代码样例

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

const int INF = 2147483640/2;
const int MAXN = 105;

char dna[MAXN][MAXN];
int a[MAXN][MAXN];

int n;

int main(){
    scanf("%d",&n);
    for (int i=1;i<=n;i++)
        scanf("%s",dna[i]);

    for (int i=1;i<=n;i++)
        for (int j=1;j<=n;j++)
            a[i][j] = INF;

    for (int i=1;i<=n;i++)
        for (int j=i;j<=n;j++){
            int cnt = 0;
            for (int k=0;k<MAXN;k++) cnt += (dna[i][k]!=dna[j][k]);
            a[i][j] = a[j][i] = cnt*cnt;
        }

    for (int k=1;k<=n;k++)
        for (int i=1;i<=n;i++)
            for (int j=1;j<=n;j++)
                if (a[i][j] > a[i][k]+a[k][j])
                    a[i][j] = a[i][k]+a[k][j];

    int ans = INF;
    for (int i=1;i<=n;i++){
        int cnt = a[i][1];
        for (int j=1;j<=n;j++)
```

```
39              if (cnt < a[i][j])
40                  cnt = a[i][j];
41          if (cnt<ans)
42              ans = cnt;
43      }
44
45      printf("%d\n",ans);
46      return 0;
47  }
48  /*************************************************************
49      Problem: 1559
50      User: 171860696
51      Language: C++
52      Result: 正确
53      Time:8 ms
54      Memory:1008 kb
55  *************************************************************/
```

Listing 1: A by 171860696

## 2 Problem 3-7-B: FLY

### 2.1 代码样例

```
1   #include<iostream>
2   #include<stdio.h>
3   #include<algorithm>
4   #define maxsize 105
5   #define inf 0x0fffffff
6   #define min(a,b) a>b?b:a;
7   using namespace std;
8   struct point {
9       int x;
10      int y;
11  };
12  int n, m1, m2, k, t, x, y, tp;
13  int mw[maxsize][maxsize];
14  int fw[maxsize][maxsize];
15  point nxt[maxsize];
16  int cost[maxsize];
17  void ini() {
18      for (int i = 0; i < maxsize; ++i) {
19          for (int j = 0; j < maxsize; ++j) {
20              if (i == j) {
21                  mw[i][j] = 0;
22                  fw[i][j] = 0;
23              }
24              else{
25                  mw[i][j] = inf;
26                  fw[i][j] = inf;
27              }
28          }
29          cost[i] = inf;
30      }
31  }
32  void floyd() {
33      for (int k = 0; k < n; ++k) {
34          for (int i = 0; i < n; ++i) {
35              for (int j = 0; j < n; ++j) {
36                  mw[i][j] = min(mw[i][k] + mw[k][j], mw[i][j]);
37                  fw[i][j] = min(fw[i][k] + fw[k][j], fw[i][j]);
38              }
39          }
40      }
41  }
42  int main() {
43      scanf("%d %d %d", &n, &m1, &m2);
44      scanf("%d %d", &t, &k);
45      ini();
46      for (int i = 0; i < t; ++i) {
47          scanf("%d", &tp);
48          nxt[i].x = tp − 1;
49      }
50      for (int i = 0; i < t; ++i) {
51          scanf("%d", &tp);
52          nxt[i].y = tp − 1;
```

```cpp
53        }
54        for (int i = 0; i < m1; ++i) {
55            scanf("%d %d %d", &x, &y, &tp);
56            mw[x−1][y−1] = tp;
57            //mw[y-1][x-1] = tp;
58        }
59        for (int i = 0; i < m2; ++i) {
60            scanf("%d %d %d", &x, &y, &tp);
61            fw[x−1][y−1] = tp;
62            //fw[y-1][x-1] = tp;
63        }
64        floyd();
65        for (int i = 0; i < t; ++i) {
66            cost[i] = min(mw[0][nxt[i].x] + fw[nxt[i].x][nxt[i].y], inf);
67        }
68        sort(cost, cost + t);
69        int sum = 0;
70        for (int i = 0; i < k; ++i) {
71            if (cost[i] == inf) {
72                sum = −1;
73                break;
74            }
75            sum += cost[i];
76        }
77        printf("%d\n", sum);
78
79    }
80
81    /*************************************************************
82        Problem: 1560
83        User: 171240542
84        Language: C++
85        Result: 正确
86        Time:4 ms
87        Memory:1640 kb
88    *************************************************************/
```

Listing 2: B by 171240542

# 3   Problem 3-7-C: 单身狗的烦恼

## 3.1   代码样例

```
1  #include<bits/stdc++.h>
2  using namespace std;
3  const int N=4e5+5;
4  #define INF 0x3f3f3f3f
5  #define ll long long int
6  int n,m,tot;
7  int first[N<<1],nxt[N<<1],to[N<<1];
8  ll cost[N<<1],d[N],c[N];
9  bool vis[N];
10 struct node{
11     ll ind,d;
12     node (ll x,ll y){
13         ind=x;d=y;
14     }
15     bool operator < (const node &b) const {
16         return d>b.d;
17     }
18 };
19 void adde(int u,int v,ll w){
20     nxt[++tot]=first[u];
21     first[u]=tot;
22     to[tot]=v;
23     cost[tot]=w;
24 }
25
26 void dij(int s){
27     memset(vis,0,sizeof(vis));
28     memset(d,−1,sizeof(d));
29     priority_queue<node>q;
30     q.push(node(s,0));
31     d[s]=0;
32     while (!q.empty()){
33         node x=q.top();q.pop();
34         ll u=x.ind;
35         if (vis[u]) continue;
36         vis[u]=1;
37         for (int j=first[u];j;j=nxt[j]){
38             int v=to[j];
39             if (d[v]==−1 || d[v]>d[u]+cost[j]){
40                 d[v]=d[u]+cost[j];
41                 q.push(node(v,d[v]));
42             }
43         }
44     }
45 }
46
47 int main(){
48     scanf("%d%d",&n,&m);
49     for(int i=0;i<m;i++){
50         int u,v;
51         ll w;
```

```
52      scanf("%d%d%lld",&u,&v,&w);
53      adde(u,v,w<<1);
54      adde(v,u,w<<1);
55    }
56    for (int i=1;i<=n;i++) {
57      scanf("%lld",&c[i]);
58      adde(0,i,c[i]);
59    }
60    dij(0);
61    for (int i=1;i<=n;i++) printf("%lld ",d[i]);
62    return 0;
63  }
64
65  /************************************************************
66      Problem: 1561
67      User: 171860547
68      Language: C++
69      Result: 正确
70      Time:532 ms
71      Memory:29972 kb
72  ************************************************************/
```

Listing 3: C by 171860547

# 4   Problem 3-7-D: 抓小黑大赛

## 4.1   代码样例

```cpp
#include<iostream>
#include<cstdio>
#include<cstring>
#include<algorithm>
using namespace std;
const int INF=0x00700000;

int n,m,w;
int F[122][122];
int D[122][122][122];
int W[300][300];

void Floyd(){
    for(int i=1;i<=n;i++)
    for(int j=1;j<=n;j++)
    for(int k=1;k<=n;k++){
        if(F[j][i]+F[i][k]<F[j][k])
        F[j][k] = F[j][i]+F[i][k];
    }
}

void Hfloyd(){
    for(int cnt=1;cnt<=n;cnt++)
    for(int i=1;i<=n;i++)
    for(int j=1;j<=n;j++)
    for(int k=1;k<=n;k++){
        if(D[cnt][j][i]+D[cnt][i][k]<D[cnt][j][k]){
            D[cnt][j][k] = D[cnt][j][i]+D[cnt][i][k];
        }
    }
}

void INIT(){
    for(int i=1;i<=n;i++)
    for(int j=1;j<=n;j++){
        if(i==j) F[i][j]=0;
        else F[i][j]=INF;
    }
}

int main()
{
    scanf("%d%d%d",&n,&m,&w);
    INIT();
    int u,v,t;
    for(int i=1;i<=m;i++){
        scanf("%d%d%d",&u,&v,&t);
        F[u][v]=t;
    }
    for(int k=1;k<=n;k++){
        for(int i=1;i<=n;i++)
```

```
52          for(int j=1;j<=n;j++){
53              if((k==i||k==j)&&i!=j){
54                  D[k][i][j]=INF;
55              }
56              else
57                  D[k][i][j]=F[i][j];
58          }
59      }
60      Floyd();
61      Hfloyd();
62      for(int i=1;i<=w;i++)
63      for(int j=1;j<=n;j++)
64      scanf("%d",&W[i][j]);
65      for(int i=1;i<=w;i++){
66          int min=INF;
67          for(int j=1;j<=n;j++){
68              int temp1=W[i][j];
69              int temp2=W[i][temp1];
70              if(min>D[temp1][j][temp2]+F[temp2][temp1]+F[temp1][temp2])
71              min=D[temp1][j][temp2]+F[temp2][temp1]+F[temp1][temp2];
72          }
73          if(min<INF)
74          printf("%d\n",min);
75          else
76          printf("bug\n");
77      }
78      return 0;
79 }
80 /************************************************************
81     Problem: 1562
82     User: 171240521
83     Language: C++
84     Result: 正确
85     Time:528 ms
86     Memory:9052 kb
87 ************************************************************/
```

Listing 4: D by 171240521