All Contests > APL-2017-L8 > Betweenness Centrality

Betweenness Centrality   🔒 locked

Ⓗ by volmahesh

Problem	Submissions	Leaderboard	Discussions

This assignment expands on the concepts of Weekend 7 (Dijk or Dyck?).

> Given a undirected simple graph G with positive integer weighted edges, calculate the Betweenness Centrality (henceforth abbreviated **BC**) metric for each node in G.

BC is defined as follows:

$$BC(v) = \sum_{s \neq v \neq t} \frac{\sigma_{st}(v)}{\sigma_{st}}$$

where,

$\sigma_{st}(v)$ = Number of shortest paths between s and t that pass through v.

σ_{st} = Total number of shortest paths between s and t.

This assignment requires you to calculate **BC** for all v in G with a total worst case complexity of $O(N^3)$.

As in the previous assignment,
There are N vertices and M edges in G.
Vertices are labelled 0 to N-1.
You will be given the number of edges in G and the edge list.

Most test cases will deal with dense graphs i.e., $M >> N$

Hint: Try calculating all-pairs shortest paths.

Input Format

```
N  M
u1 v1 w1
u2 v2 w2
...
uM vM wM
```

Constraints

$N < 500$

$0 < w_i < 1000$

$\forall u, v \in G, \quad d_{min}(u, v) < 2^{32}$

$\forall u, v \in G, \quad \sigma_{uv} < 2^{32}$

Output Format

```
BC(0)
BC(1)
...
BC(N-1)
```

NOTE 1: Your output precision must be at least **1e-5**.

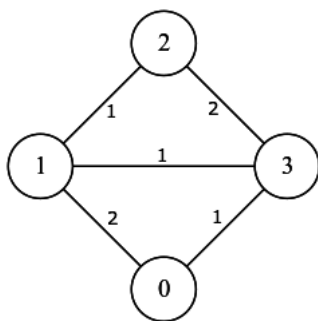**NOTE 2:** Print 1 entry per line. Otherwise, you might get "Wrong Answer" because of HR limitations.

Sample Input

```
4 5
0 3 1
3 2 2
1 3 1
0 1 2
1 2 1
```

Sample Output

```
0.0
1.1666666666666665
0.0
1.1666666666666665
```

Explanation

$$BC(0) = \frac{\sigma_{12}(0)}{\sigma_{12}} + \frac{\sigma_{13}(0)}{\sigma_{13}} + \frac{\sigma_{23}(0)}{\sigma_{23}} = \frac{0}{1} + \frac{0}{1} + \frac{0}{2} = 0$$

$$BC(1) = \frac{\sigma_{02}(1)}{\sigma_{02}} + \frac{\sigma_{03}(1)}{\sigma_{03}} + \frac{\sigma_{23}(1)}{\sigma_{23}} = \frac{2}{3} + \frac{0}{1} + \frac{1}{2} = \frac{7}{6} = 1.1\bar{6}$$

$$BC(2) = \frac{\sigma_{01}(2)}{\sigma_{01}} + \frac{\sigma_{03}(2)}{\sigma_{03}} + \frac{\sigma_{13}(2)}{\sigma_{13}} = \frac{0}{2} + \frac{0}{1} + \frac{0}{1} = 0$$

$$BC(3) = \frac{\sigma_{01}(3)}{\sigma_{01}} + \frac{\sigma_{02}(3)}{\sigma_{02}} + \frac{\sigma_{12}(3)}{\sigma_{12}} = \frac{1}{2} + \frac{2}{3} + \frac{0}{1} = \frac{7}{6} = 1.1\bar{6}$$

Submissions: 60

Max Score: 10

Difficulty: Medium

Rate This Challenge:

☆ ☆ ☆ ☆ ☆

More

Current Buffer (saved locally, editable)   C++

```cpp
 1  #include <cmath>
 2  #include <cstdio>
 3  #include <vector>
 4  #include <iostream>
 5  #include <algorithm>
 6  #define MAXLim 120000
 7  using namespace std;
 8
 9  int mini(int a,int b){
10      if(a>b){
11          return b;
12      }
13      return a;
```

```
14  }
15
16
17 ▾ int main() {
18      int N;
19      int M;
20      cin >> N;
21      cin >> M;
22 ▾    int ar[N][N],br[N][N],pa[N][N];
23      int i=0,j=0,k=0,p=0,q=0;
24 ▾    for(int i=0;i<N;i++){
25 ▾        for(int j=0;j<N;j++){
26 ▾            ar[i][j] = MAXLim;
27 ▾            if(i==j){
28 ▾                ar[i][j] = 0;
29              }
30          }
31      }
32
33
34
35
36
37      int u,v,w;
38 ▾    for(i=0;i<M;i++){
39          cin >> u;
40          cin >> v;
41          cin >> w;
42 ▾        ar[u][v] = w;
43 ▾        ar[v][u] = w;
44      }
45
46 ▾    for(i=0;i<N;i++){
47 ▾        for(j=0;j<N;j++){
48 ▾            pa[i][j] = 1;
49 ▾            if(ar[i][j]==MAXLim){
50 ▾                pa[i][j] = 0;
51              }
52          }
53      }
54
55
56
57
58
59
60 ▾    for(k=0;k<N;k++){
61 ▾        for(p=0;p<N;p++){
62 ▾            for(q=0;q<N;q++){
63 ▾                br[p][q] = ar[p][q];
64              }
65          }
66 ▾        for(i=0;i<N;i++){
67 ▾            for(j=0;j<N;j++){
68 ▾                if(i!=k && j!=k){
69
70 ▾                    if(br[i][j]>(br[i][k]+br[k][j])){
71 ▾                        pa[i][j] = (pa[i][k]*pa[k][j]);
72 ▾                        ar[i][j] = mini(br[i][j],br[i][k]+br[k][j]);
73                      }
74 ▾                    else if(br[i][j]==(br[i][k]+br[k][j])){
75 ▾                        pa[i][j] = pa[i][j] +(pa[i][k]*pa[k][j]);
76                      }
77
78                  }
79
80              }
81          }
82      }
83
84
85
86
87
88
89 ▾    double ans[N];
90
91
```

```
 92
 93 ▾      for(v=0;v<N;v++){
 94 ▾          ans[v]=0;
 95 ▾          for(i=0;i<N;i++){
 96 ▾              for(j=i+1;j<N;j++){
 97 ▾                  if(i!=v && j!=v ){
 98 ▾                      if(ar[i][j] == (ar[i][v] + ar[v][j])){
 99 ▾                          ans[v] = ans[v] + ((pa[i][v]*(pa[v][j]*(1.0)))/(pa[i][j]));
100                          }
101                      }
102                  }
103              }
104 ▾          printf("%.27f\n",ans[v]);
105          }
106
107
108          return 0;
109      }
110
```

Line: 1 Col: 1

⬆ Upload Code as File   ☐ Test against custom input   Run Code   Submit Code

Contest Calendar | Interview Prep | Blog | Scoring | Environment | FAQ | About Us | Support | Careers | Terms Of Service | Privacy Policy | Request a Feature