Week 13 - Social Network Mining

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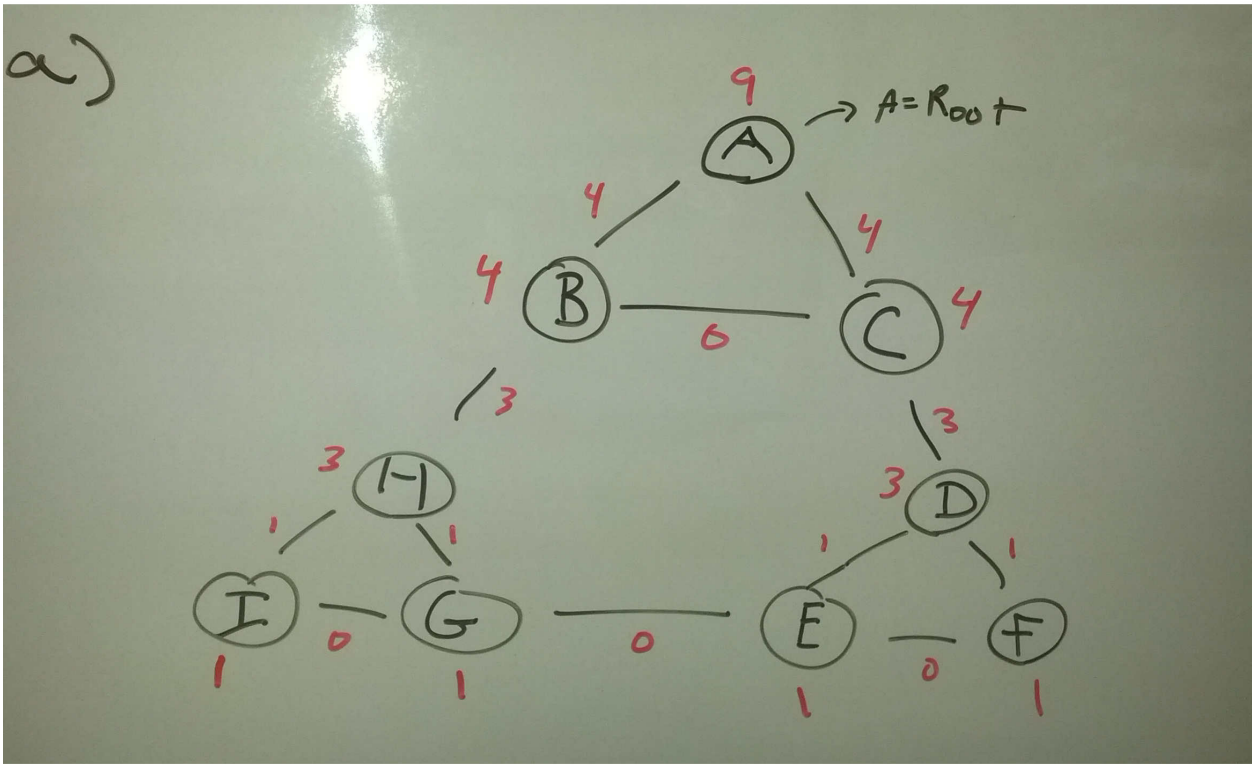
10.2.1

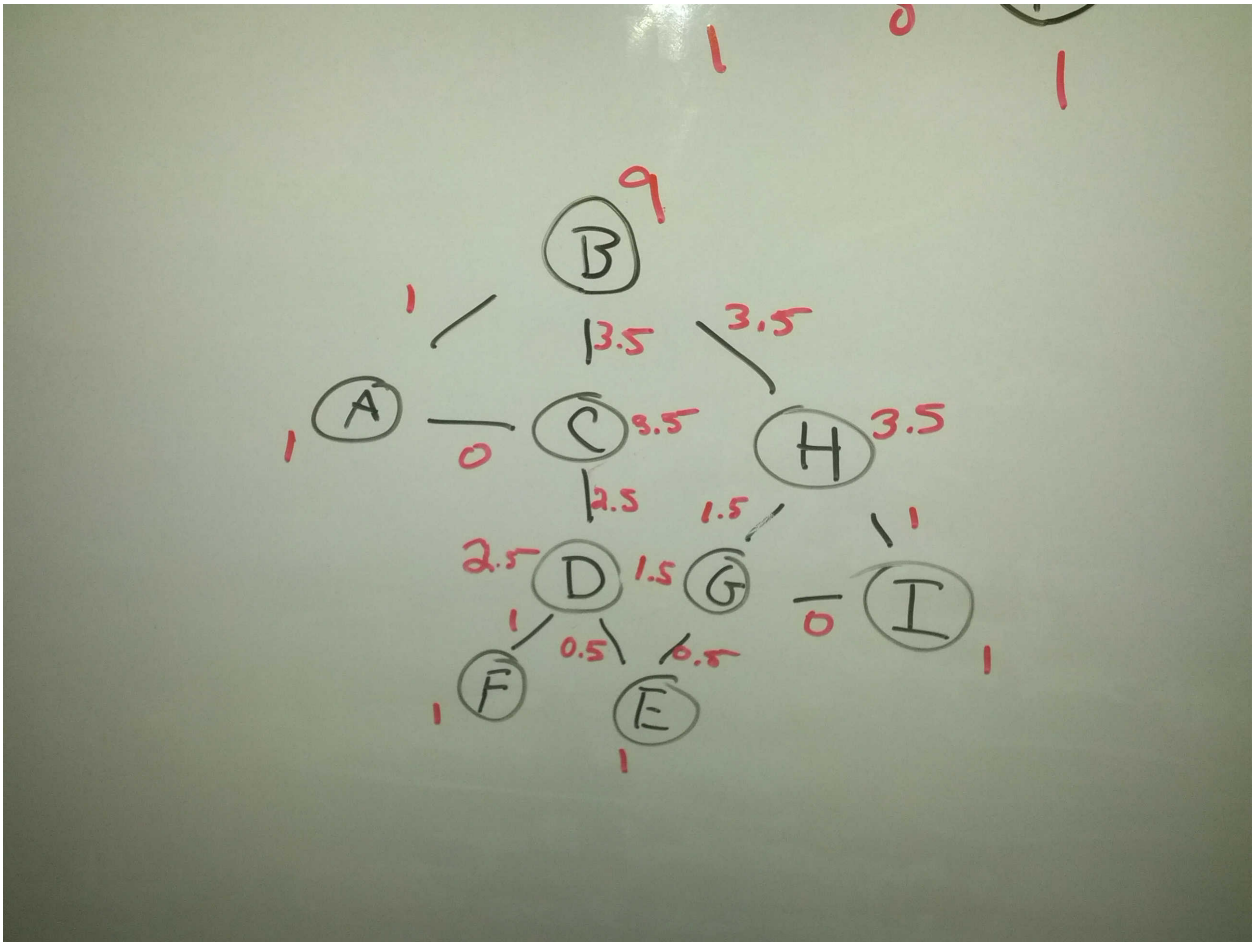
Figure 10.9 is an example of a social-network graph. Use the Girvan-Newman approach to find the number of shortest paths from each of the following nodes that pass through each of the edges. (a) A (b) B.

Answer

(a)



(B)


B
A
C
H
D
G
I
F
E

10.2.2 (section 10.2.6)

Using symmetry, the calculations of Exercise 10.2.1 are all you need to compute the betweenness of each edge. Do the calculation.

Answer

Having the diagram start with node A is the same diagram that would result if the root was I or F. That means that diagram can be counted on 3 times in the summation calculation. The other diagram with root node B is the same that would result for all the other 5 nodes for a total of 6 (B,C,D,E,H,I). Here is a listing of all the edges and thir betweeness measurements:

A - B: - When A is root: 4

- When F is root: 0
- When I is root: 1
- When B is root: 1
- When C is root:
- When D is root:
- When H is root:
- When G is root:
- When E is root:

A - C: Same as A-B due to symmetry

B - C:

B - H:

C - D:

H - I: Same as A-B due to symmetry

H - G:

I - G: Same as A-B due to symmetry

G - E:

D - E:

D - F: Same as A-B due to symmetry

E - F: Same as A-B due to symmetry

Exercise 10.4.1

For the graph of Fig. 10.9, construct:

(a) The adjacency matrix.
(b) The degree matrix.
(c) The Laplacian matrix.

Answer

```
# Setup the degree matrix
D = matrix(c(2,0,0,0,0,0,0,0,0,
             0,3,0,0,0,0,0,0,0,
             0,0,3,0,0,0,0,0,0,
             0,0,0,3,0,0,0,0,0,
             0,0,0,0,3,0,0,0,0,
             0,0,0,0,0,2,0,0,0,
             0,0,0,0,0,0,3,0,0,
             0,0,0,0,0,0,0,3,0,
             0,0,0,0,0,0,0,0,2), ncol=9)

# Setup col and row names
colnames(D)<-c('A','B','C','D','E','F','G','H','I')
rownames(D)<-c('A','B','C','D','E','F','G','H','I')

# Write up the adjanceny matrix
          #  A B C D E F G H I
A = matrix(c(0,1,1,0,0,0,0,0,0, # A
             1,0,1,0,0,0,0,1,0, # B
             1,1,0,1,0,0,0,0,0, # C
             0,0,1,0,1,1,0,0,0, # D
             0,0,0,1,0,1,1,0,0, # E
             0,0,0,1,1,0,0,0,0, # F
             0,0,0,0,1,0,0,1,1, # G
             0,1,0,0,0,0,1,0,1, # H
             0,0,0,0,0,0,1,1,0), ncol=9)

# Setup col and row names
colnames(A)<-c('A','B','C','D','E','F','G','H','I')
rownames(A)<-c('A','B','C','D','E','F','G','H','I')

# Calculate Laplacian
L = D - A
```

```
# Print results
D
```

```
##   A B C D E F G H I
## A 2 0 0 0 0 0 0 0 0
## B 0 3 0 0 0 0 0 0 0
## C 0 0 3 0 0 0 0 0 0
## D 0 0 0 3 0 0 0 0 0
## E 0 0 0 0 3 0 0 0 0
## F 0 0 0 0 0 2 0 0 0
## G 0 0 0 0 0 0 3 0 0
## H 0 0 0 0 0 0 0 3 0
## I 0 0 0 0 0 0 0 0 2
```

```
A
```

```
##   A B C D E F G H I
## A 0 1 1 0 0 0 0 0 0
## B 1 0 1 0 0 0 0 1 0
## C 1 1 0 1 0 0 0 0 0
## D 0 0 1 0 1 1 0 0 0
## E 0 0 0 1 0 1 1 0 0
## F 0 0 0 1 1 0 0 0 0
## G 0 0 0 0 0 1 0 0 1 1
## H 0 1 0 0 0 0 1 0 1
## I 0 0 0 0 0 0 0 1 1 0
```

```
L
```

```
##    A  B  C  D  E  F  G  H  I
## A  2 -1 -1  0  0  0  0  0  0
## B -1  3 -1  0  0  0  0 -1  0
## C -1 -1  3 -1  0  0  0  0  0
## D  0  0 -1  3 -1 -1  0  0  0
## E  0  0  0 -1  3 -1 -1  0  0
## F  0  0  0 -1 -1  2  0  0  0
## G  0  0  0  0 -1  0  3 -1 -1
## H  0 -1  0  0  0  0 -1  3 -1
## I  0  0  0  0  0  0 -1 -1  2
```