

Week 13 - Social Network Mining

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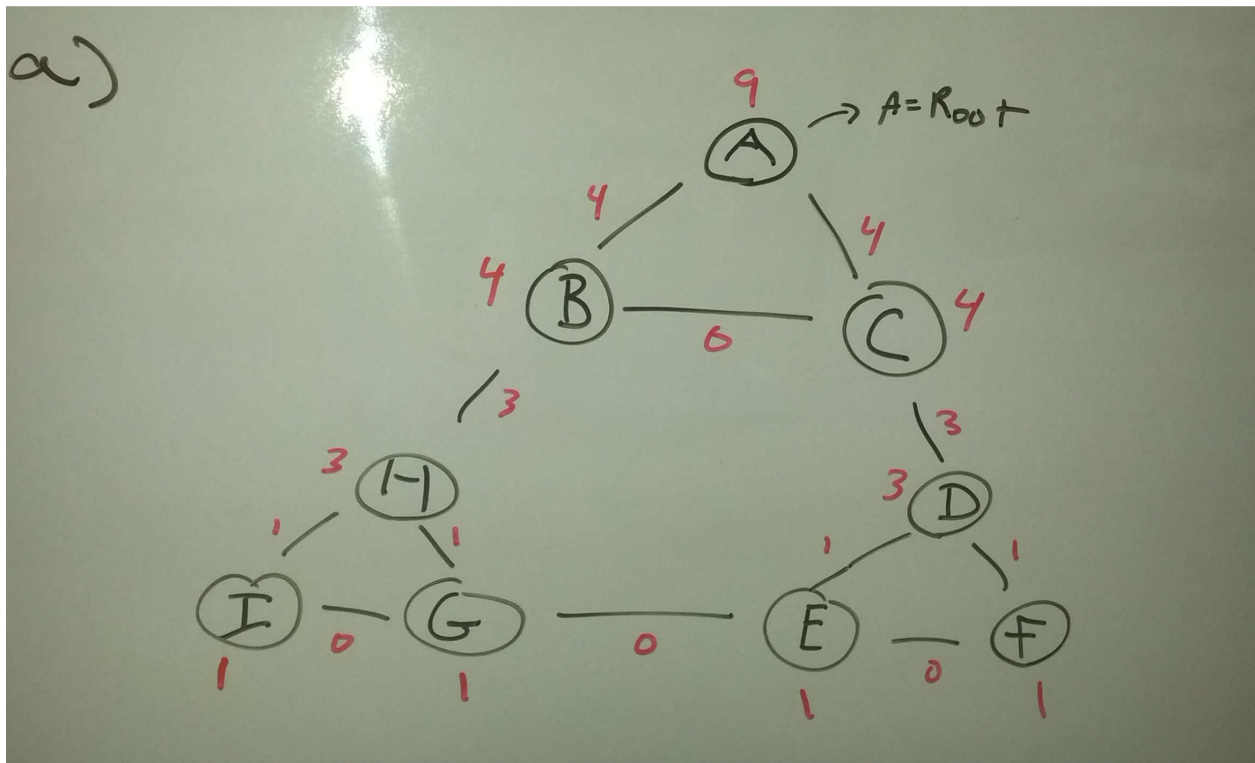
11/14/2015

10.2.1

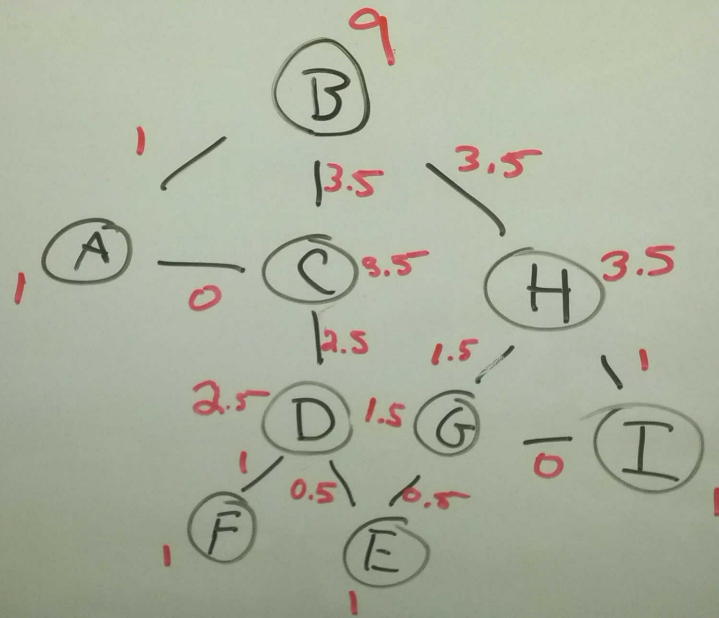
Figure 10.9 is an example of a social-network graph. Use the Girvan-Newman approach to find the number of shortest paths from each of the following nodes that pass through each of the edges. (a) A (b) B.

Answer

(a)



(B)



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 their betweenness 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,
             0,0,0,0,0,3,0,0,0,
             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 adjacency 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 0 1
## 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 1 0 0 1 1
## H 0 1 0 0 0 0 1 0 1
## I 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 0 -1
## 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
```