Network Analysis (contd ..)

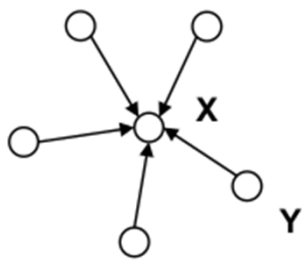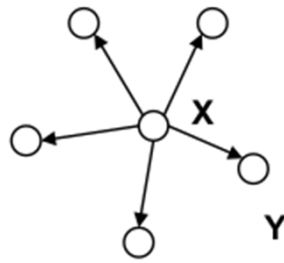# Centrality

Centrality

- A common goal in SNA (social network analysis) is to identify the "central" nodes of a network.
- What does "central" mean ?

  ❖ active?
  ❖ important?
  ❖ non-redundant?

  Definition of 'central' varies by context/purpose.
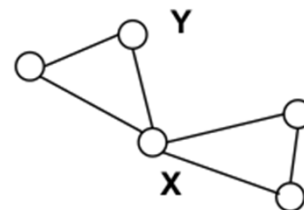
Centrality: Who's Important Based On Their Network Position
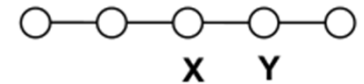

indegree   outdegree   betweenness   closeness

In each of the above networks, X has higher centrality than Y according to a particular measure

Common centrality measures

- We will define and compare three centrality measures:

  ❑ **Degree centrality (based on degree)**

  ❑ **Betweeness centrality (based on geodesics)**

  ❑ **Closeness centrality (based on average distances)**

Degree Centrality

Idea: A central actor is one with many connections.

- Undirected degree centrality (number of edges connecting to the node)
- Indegree centrality (number of edges coming into the node)
- Outdegree centrality (number of edges coming out of the node)

Degree Centrality is a best measure when number of connections is important

Indegree and Outdegree

Which countries have high indegree?
- USA
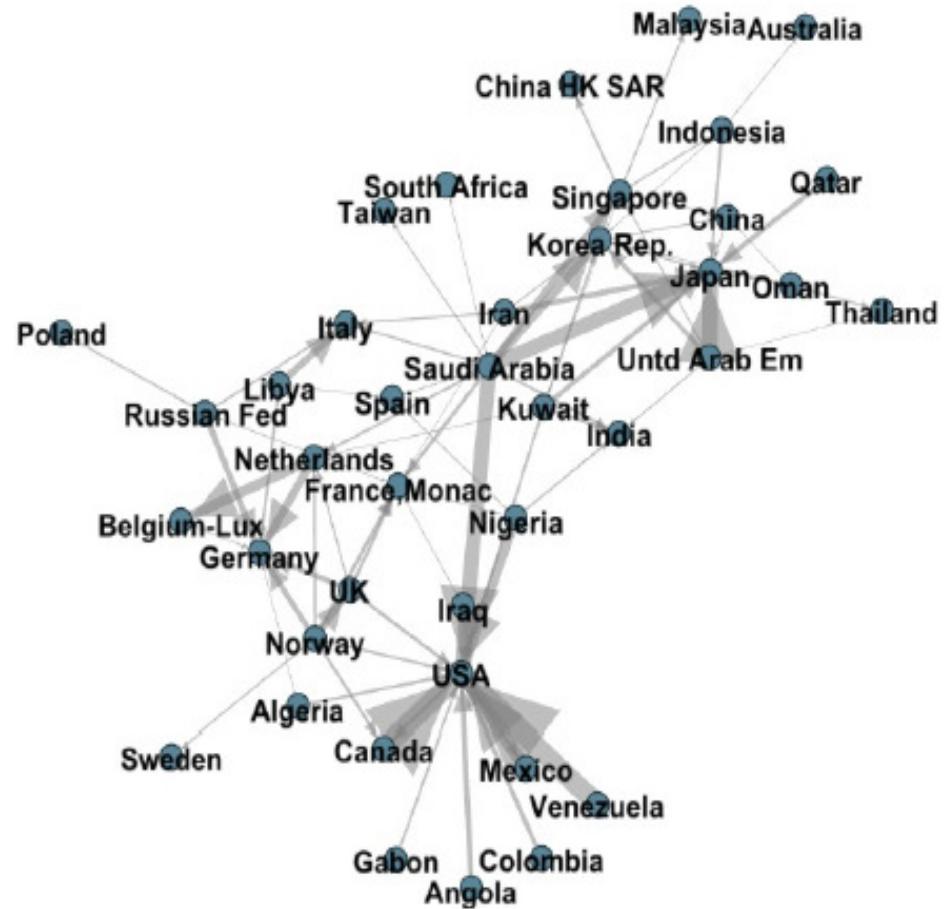- Japan
- UK

Indicates more imports to above countries
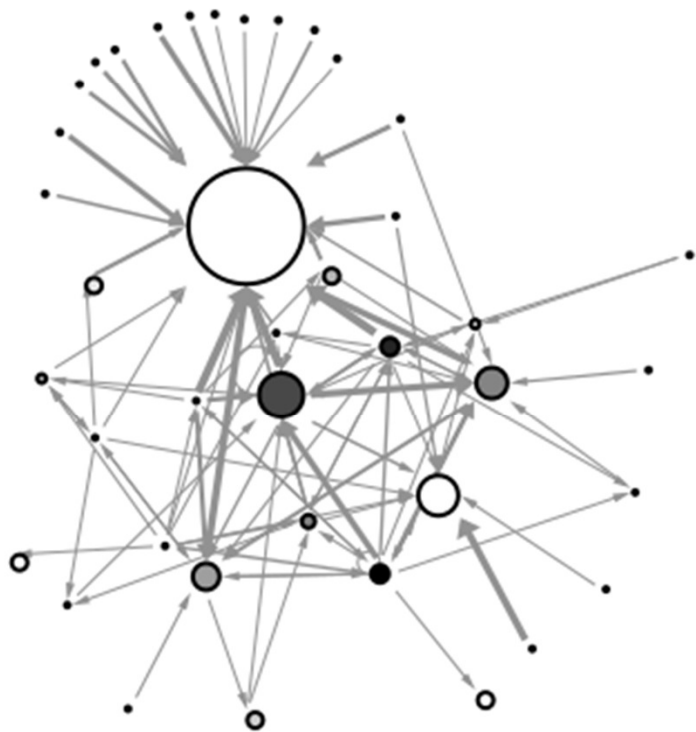
Which country has high outdegree
- Saudi Arabia
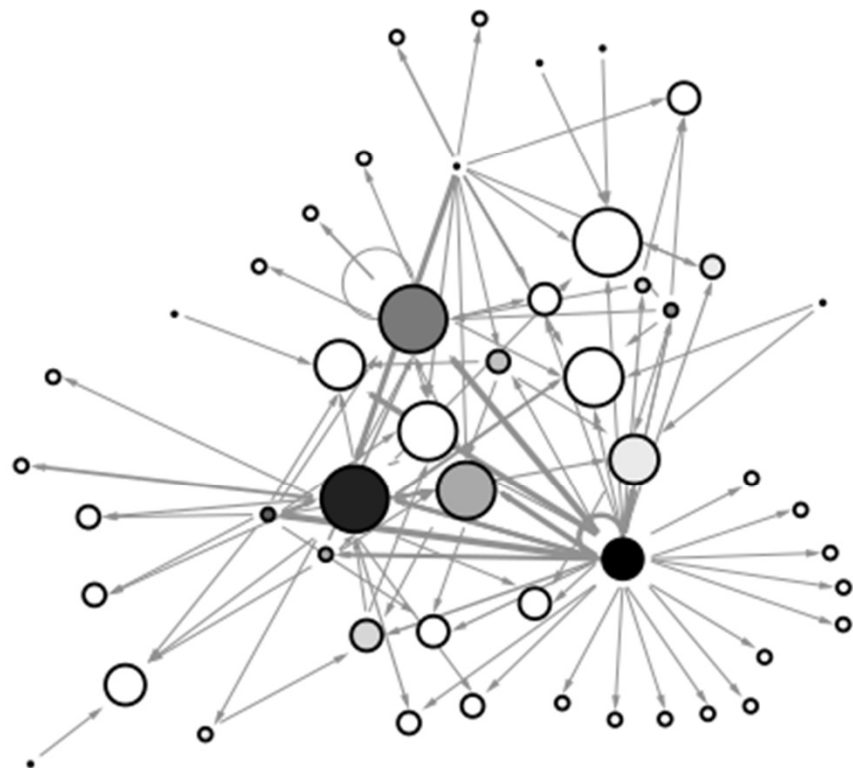
Indicates more exports from Saudi Arabia
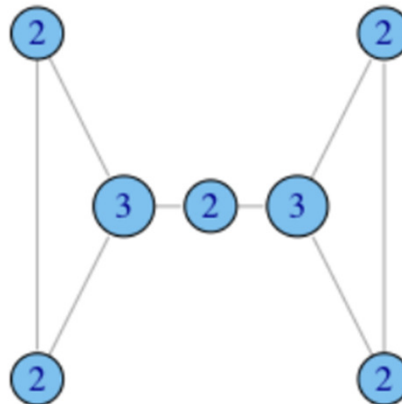
example financial trading networks

high centralization: one node trading with many others

low centralization: trades are more evenly distributed

In What Contexts May Degree Be Insufficient To Describe Centrality?

- Ability to broker between group
- Likelihood that information originating anywhere in the network reaches you…
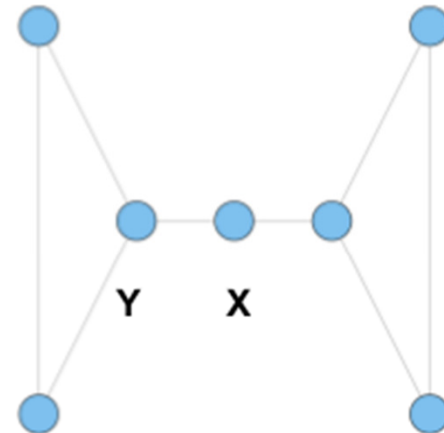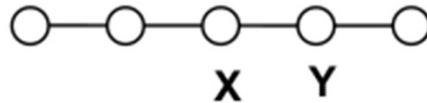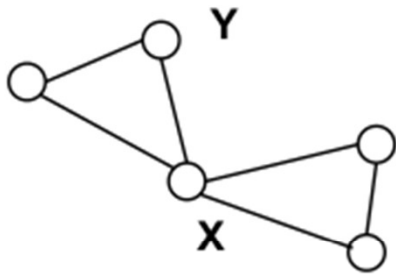
Betweenness Centrality

- Betweenness centrality quantifies the number of times a node acts as a bridge along path between two other nodes.
- Betweenness Centrality =
-

$$C_B(i) = \sum_{j<k} g_{jk}(i) / g_{jk}$$

- Where g_{jk} = the number of geodesics connecting j and k, and $g_{jk}(i)$= the number of geodesics that node i is on.

X has higher betweenness in the following graphs

Closeness Centrality

What if it's not so important to have many direct friends? (degree)

Or be "between" others (betweenness)

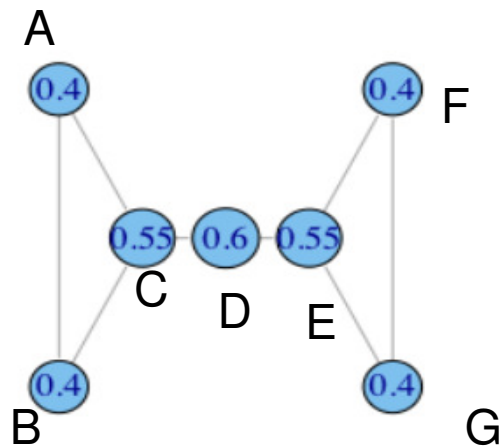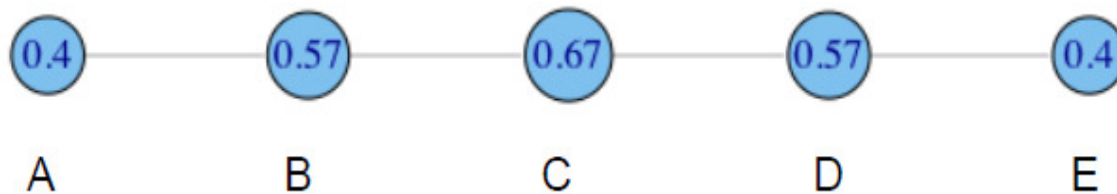But one still wants to be in the "middle" of things, not too far from the center

Closeness is based on the length of the average shortest path between a vertex and all vertices in the graph

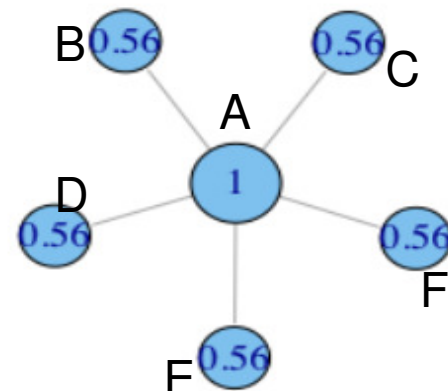$$C_c(i) = \left[\sum_{j=1}^{N} d(i,j) \right]^{-1}$$

Where d(i,j) = shortest distance from i to j

Closeness examples

C has higher closeness centrality and is closer to all nodes compared to others

D has higher closeness centrality and is closer to all nodes compared to others

A has higher closeness centrality and is closer to all nodes compared to others

Other centrality measures

There are other centrality measures :

❖Eigenvector'Centrality

❖Katz'Centrality'

References

https://www.cl.cam.ac.uk/teaching/1213/L109/stna-lecture3.pdf

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http://cs.brynmawr.edu/Courses/cs380/spring2013/section02/slides/05_Centrality.pdf

http://www2.unb.ca/~ddu/6634/Lecture_notes/Lecture_4_centrality_measure.pdf

http://cs224w.stanford.edu

Thank you