ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ

UNIVERSITY OF PIRAEUS

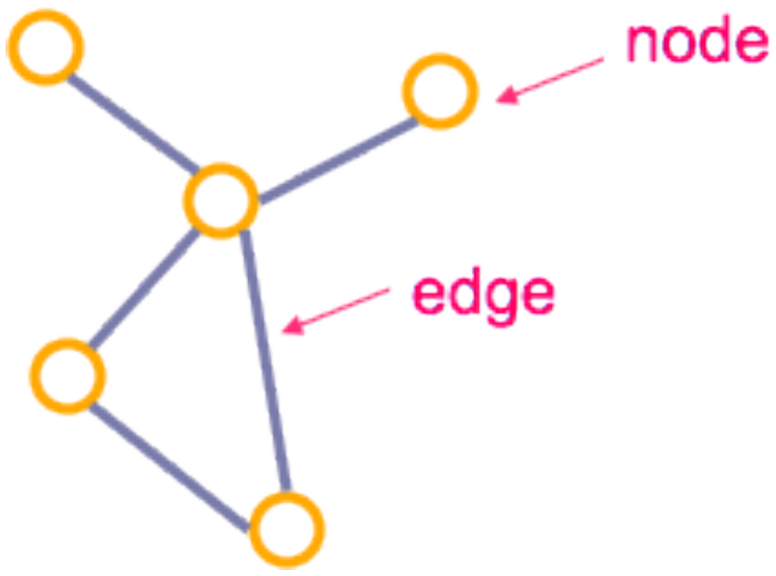
Social Network Analysis
&
Social Media Analytics

Lecture 1.1: Introduction to SNA

Representing Social Networks

Networks as Graphs:

- Sets of *points* joined with *lines,* showing **patterns of interconnections** among entities
- Points = **Nodes**
- Lines = **Edges** or **Links**



points	lines	field
vertices	edges, arcs	math
nodes	links	computer science
sites	bonds	physics
actors	ties/relations	sociology

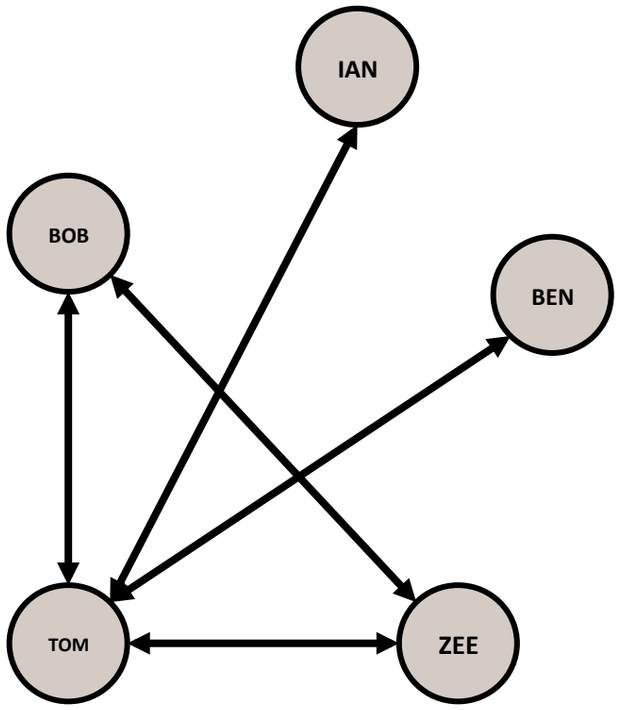
Types of Networks

Nodes can be any entity participating in a set of relationships

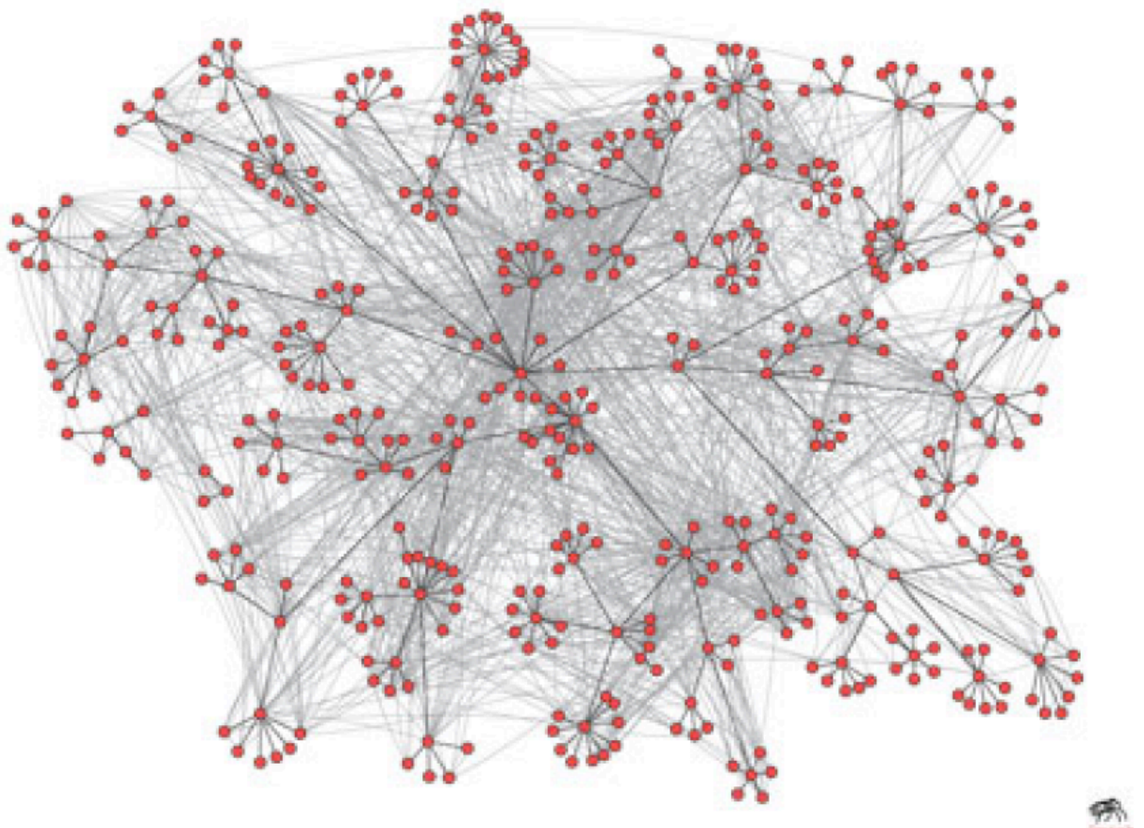
- People (as friends, colleagues, etc.)
- Organizations
- Countries
- Documents (papers, webpages, etc.)
- and many others

Links may represent any type of relationship between nodes

- Friendships, cross-references
- Communication, information exchange
- and many others



A friendship network

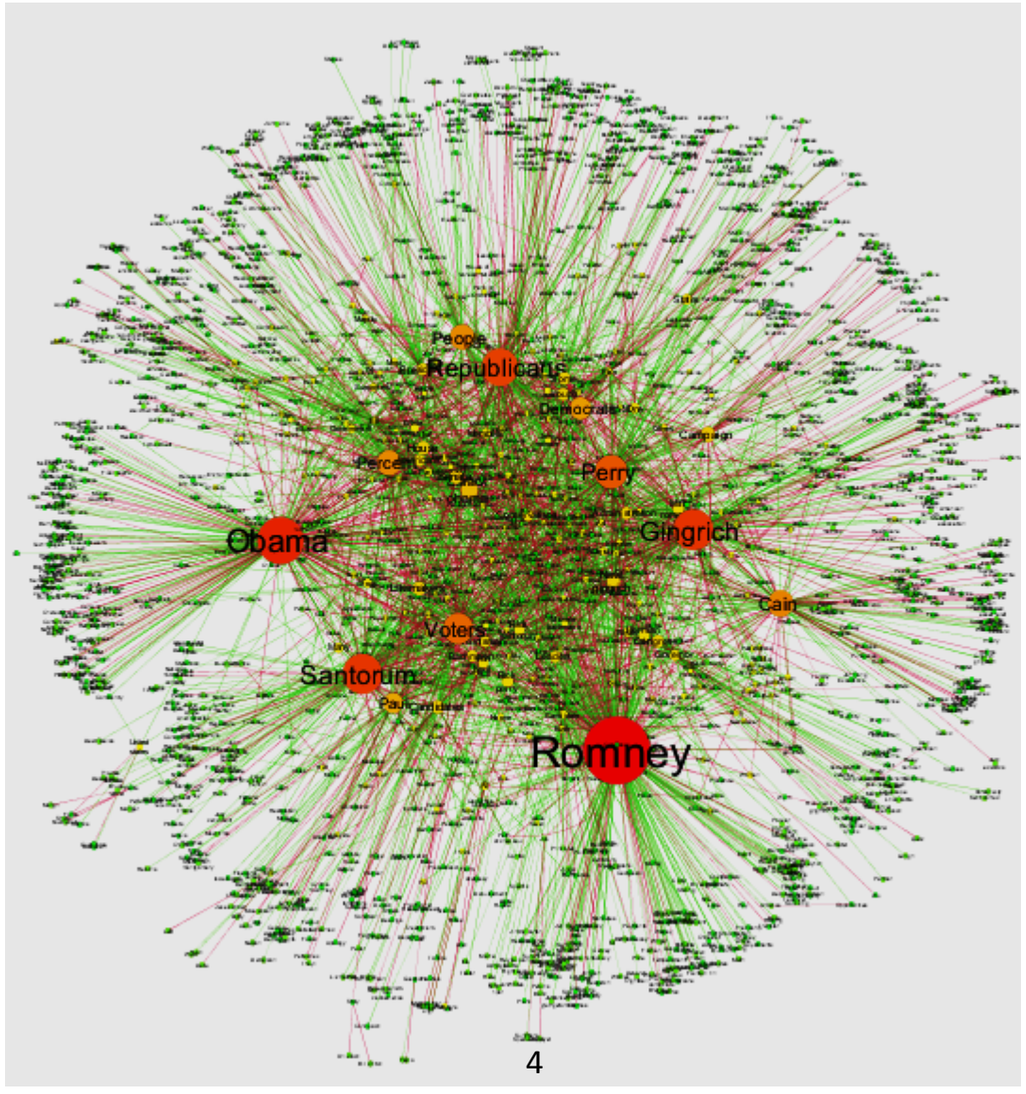


An e-mail exchange network

Network Visualization and Structural Properties

- **Networks can be complex to represent, especially as size increases**
  - Visual representation affects (careless) analysis!
  - Algorithms for network visualization

- **Popularity is an elusive and inadequate measure of significance**
  - There are many aspects affecting one's significance, such as position within the network, number of connections, mediating role, importance of connections, etc.



Why study social networks?

While the <u>individual</u> components of a system are important, of equal (if not more) importance is the <u>pattern of connections</u> between these components

- These patterns may affect the structure, behavior, and performance of the system more than its participating entities
- **Different networks of the same people will exhibit different properties and behavior**
- The collective outcome of a social system is almost always very different from the sum of its parts

Why study social networks?

Scientists have long developed tools for analyzing, modeling and understanding network structures

- Many scientific fields involved (mathematics, statistics, economics, sociology, biology, computer science, and many more)

Many questions arising in (human) social networks can be answered by borrowing knowledge from other fields

- **Epidemics (medicine)** has long studied how diseases spread through a population – a YouTube video can become viral through a similar process
- **Graph theory (mathematics)** can answer questions, such as: who is the best connected node in a graph? What is the shortest path connecting two entities?
- **Game theory (economics)** addresses issues related to strategic behavior and payoffs in network settings

Example network properties

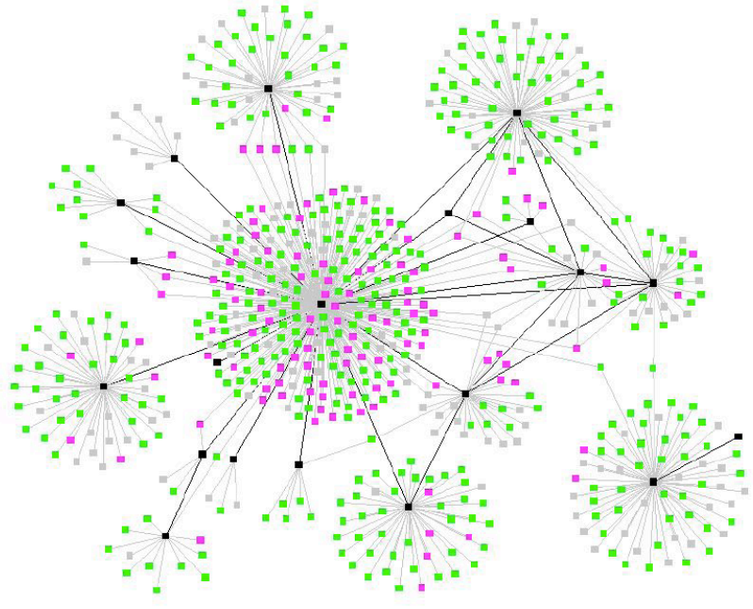
- **Hubs**
  - Few nodes with extremely high degree (lots of connections)
  - What are their implications in a network setting? (influence, learning)

- **Small worlds**
  - On average, distances between nodes are very small, compared to the size of the network ("six degrees of separation")
  - Repercussions with regards to information diffusion

- **Communities**
  - The way a network breaks into distinct communities might reveal information about it (for example, an organization) that are not visible without network analysis

What do we study in networks?

Two main sets of questions:



1. Structure and evolution

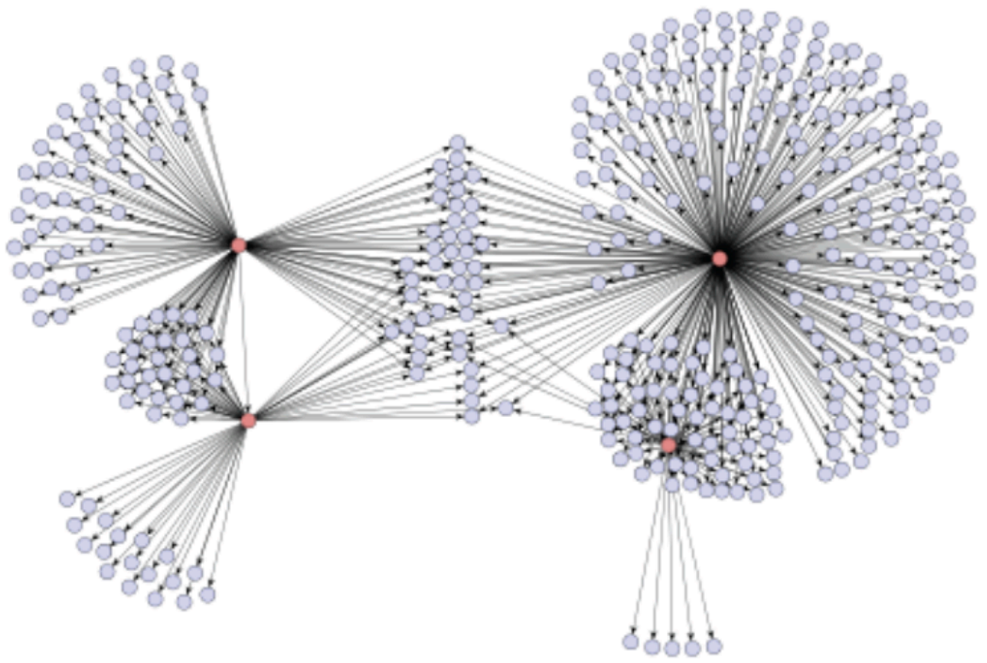
Static / Dynamic aspects of network topology

2. Behavior

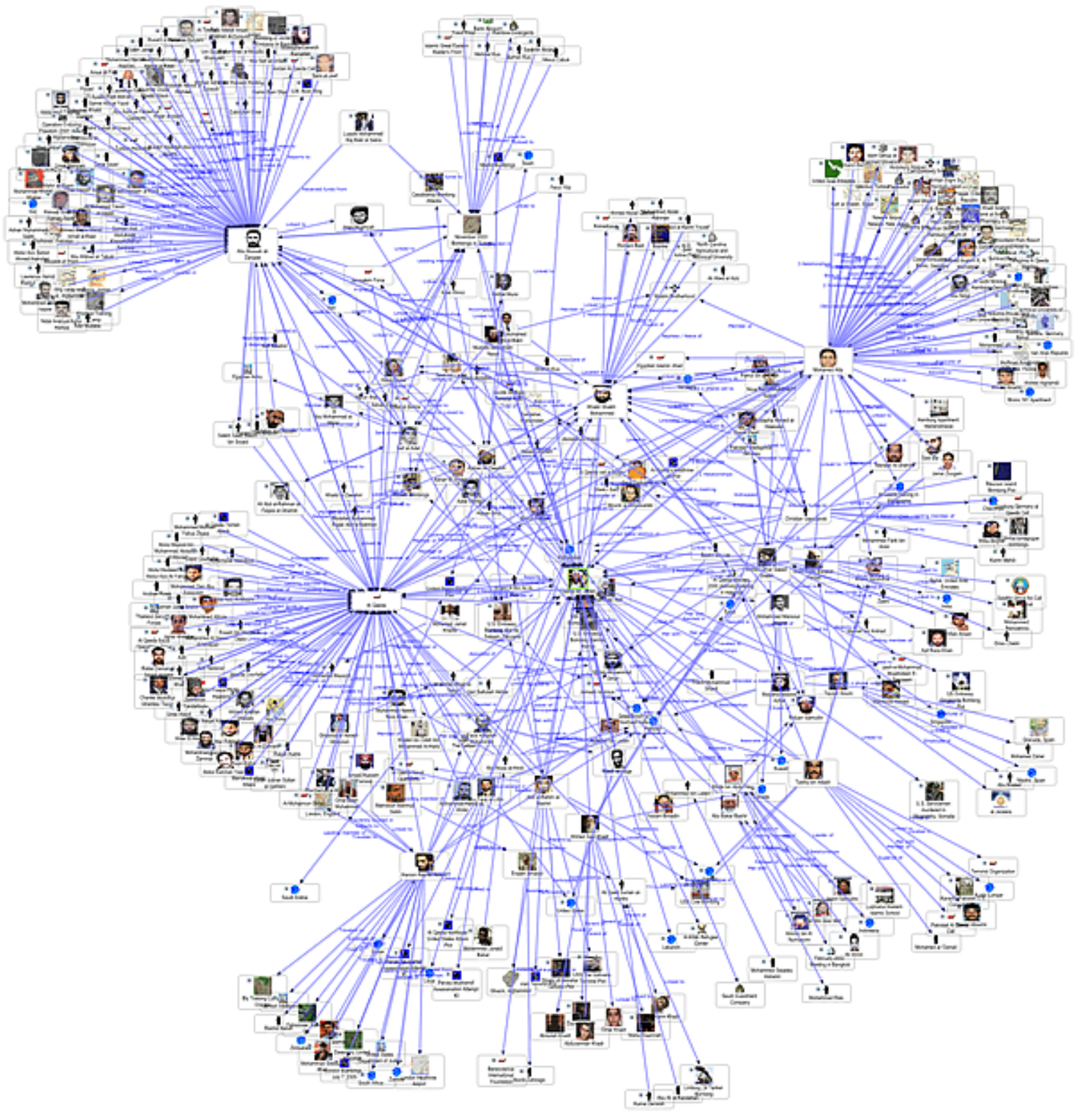
Information diffusion/propagation

Opinion/Belief formation

Actors' choices and resulting outcomes (learning, herding)



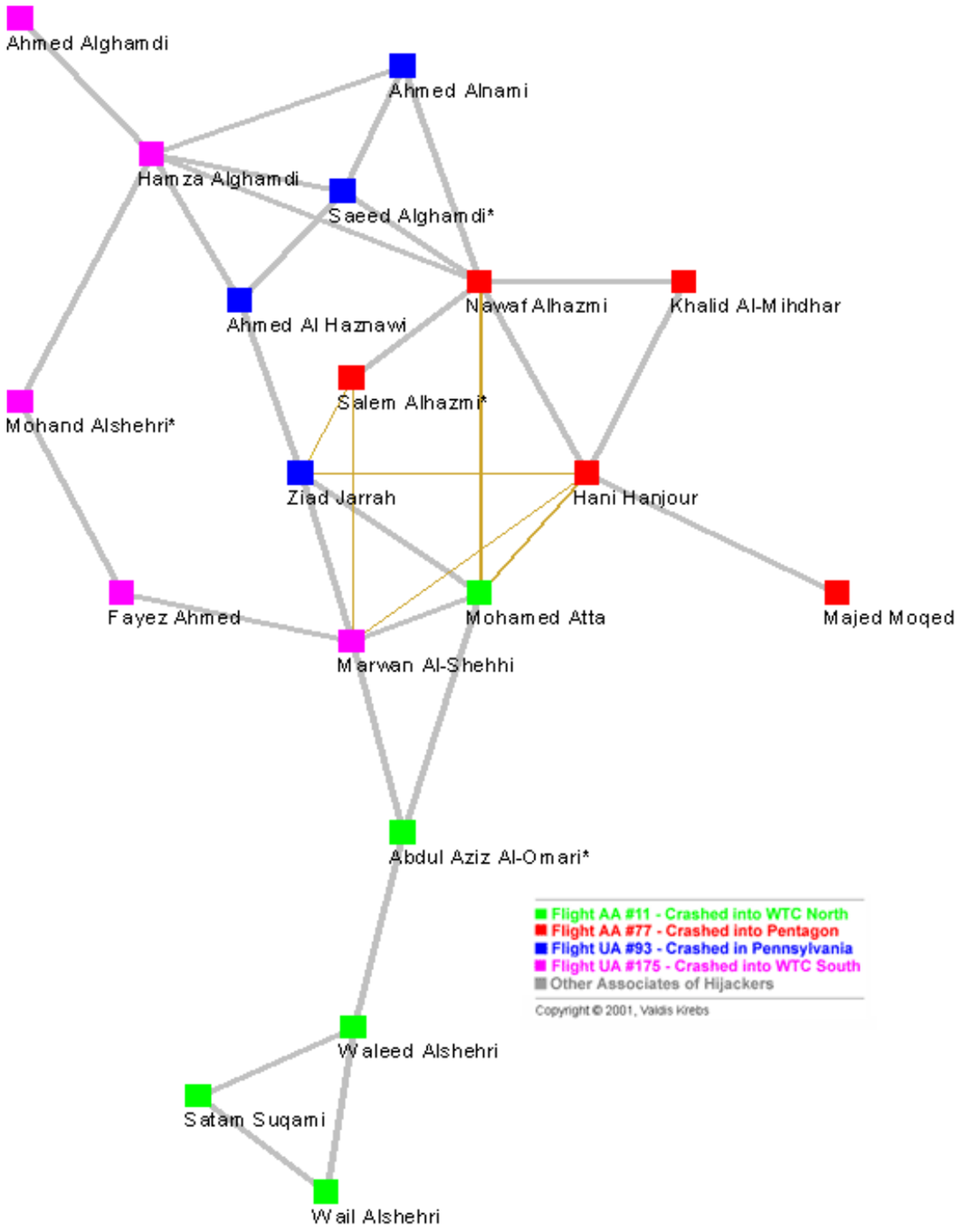
Example: online social networks



- Facebook, Twitter, etc.
- Blogs, blog entries
- E-mail exchange networks
- Discussion forums

- Strength of friendships
- Influence
- Social Learning

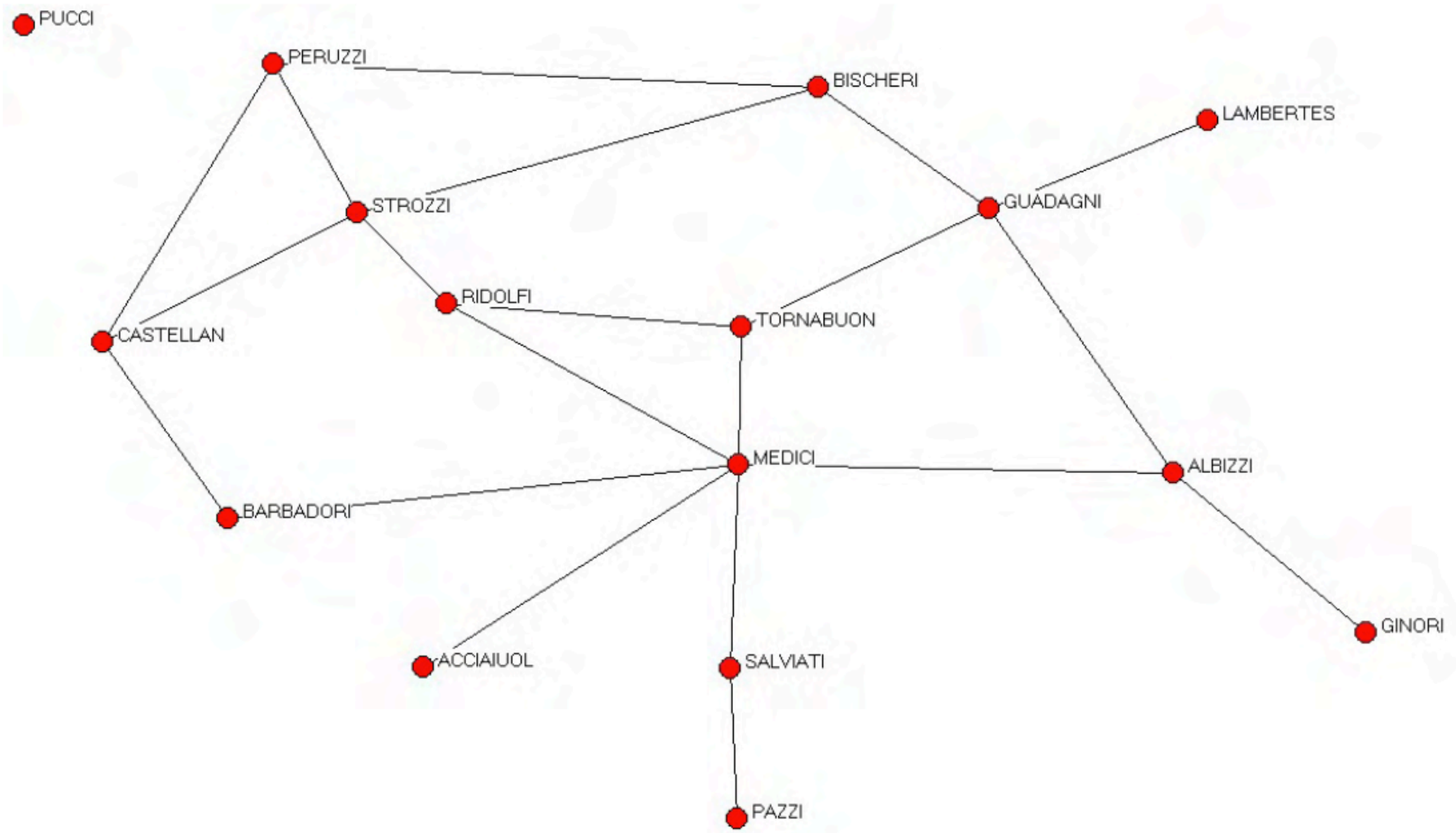
Example: a network of terrorists



- Sparse network.
- Members of the same team are far from each other and beyond the horizon of observability
- Less damage to the network if someone is captured or compromised
- Trade efficiency for secrecy.

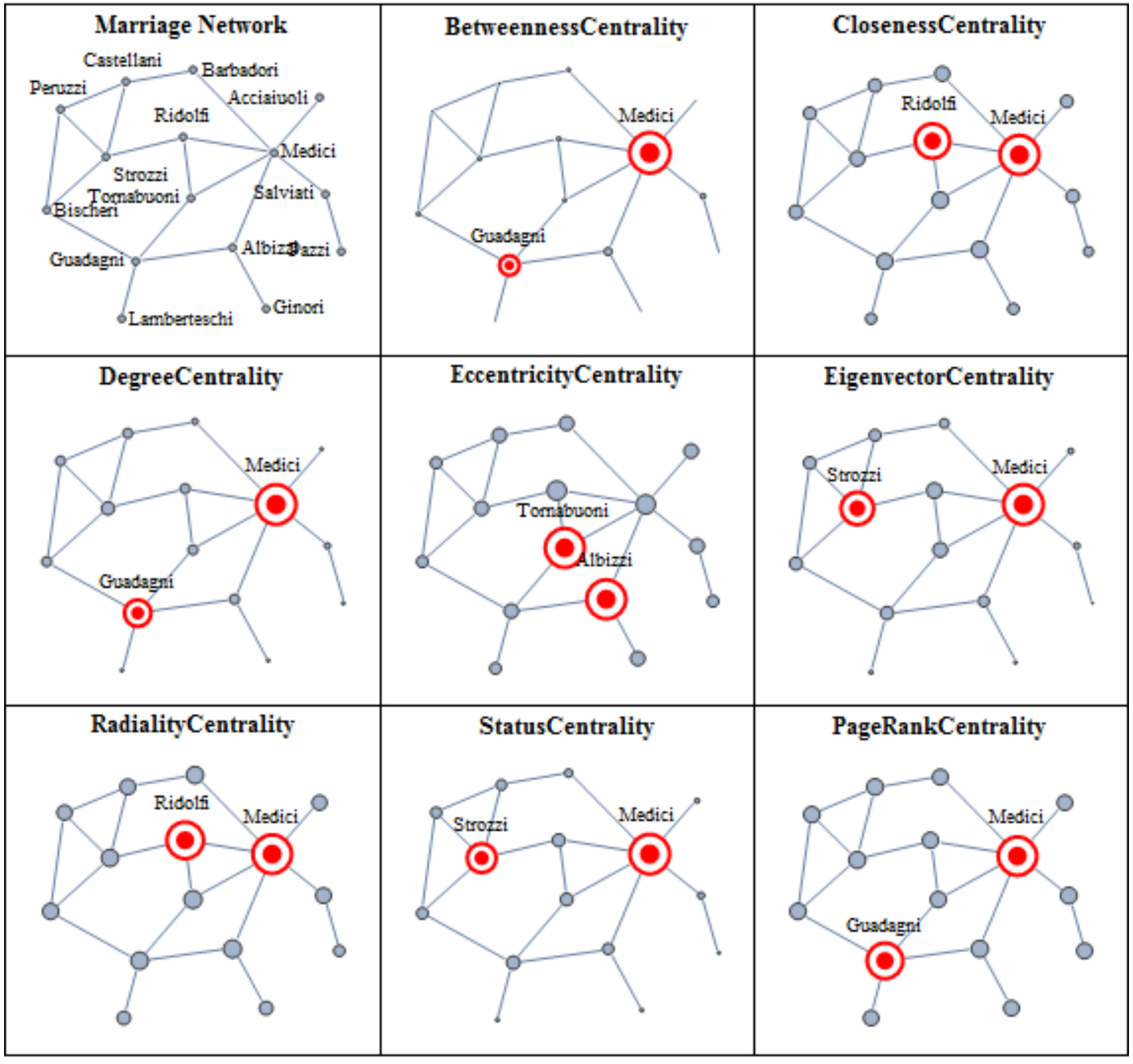
Krebs, V. E. (2002), Uncloaking Terrorist Networks, First Monday, (7) 4, http://journals.uic.edu/ojs/index.php/fm/article/view/941/863

Example: power networks



How the 15th century Medici family rose to power in Florence, while not having the greatest wealth or the most seats in legislature *(Jackson, M.O., Social and Economic Networks, Princeton University Press, 2008.)*

Example (cont.): the Florentine marriages



- Through marriages, the Medici had a crucial position of **centrality** in the social network (communication, brokering deals, etc.)
- For example, they lie on 52% of all shortest paths, followed by Guadagni (25%) and Strozzi (10%)

http://www.wolfram.com/mathematica/new-in-9/social-network-analysis/centrality-and-prestige-of-florentine-families.html