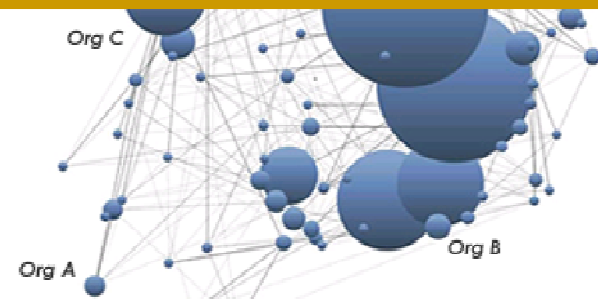


Complex Networks and Enterprises
Session 1 | Introduction

<http://www.ti.gatech.edu/basole/seminar/networks/>



Dr. Rahul Basole

- I grew up in Cologne, Germany
- I have degrees from Virginia Tech, University of Michigan, Stanford University, and GaTech
- At Georgia Tech since 2002 - with the Tennenbaum Institute since 2004
- I have published in engineering, computer science, and management journals
- Research Interests:
 - Business Ecosystems
 - Innovation
 - IT Strategy
 - Emerging Technologies
- My daughter is turning 1 this weekend.

Who are you?

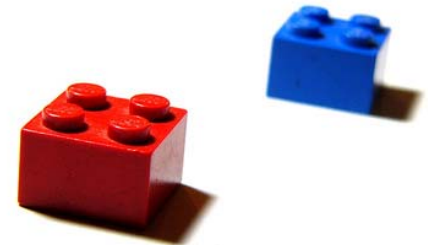
- Name
- College/School at Georgia Tech
- Research Interest(s)
- Anything else you may want to share

What core skills I want you to gain ...

- Seeing the “Network”
- Mapping the “Network”
- Analyzing the “Network”

My Confession: Experimental Graduate Seminar (Take 2)

- No Similar Graduate Course Anywhere
 - Interdisciplinary Class
 - Multi Perspective
- No Formal Technical Prerequisites
 - I know you have the technical background
 - Focus will be on concepts, ideas, and application
 - I stand by the “Lego Principle” → think, conceptualize, build, test, take apart, try again
- A Good Amount of Reading
 - I tried to keep readings to a minimum, but even then it can seem like a lot
 - Focus will be on “integration” and “big picture” thinking
 - And it will be fun reading, I promise. Cases, articles, etc.
- Combination of Some Theory, Some Lecture, Hands-On Work, and Guest Speakers
 - The course is run as a seminar. We all present the lectures.
 - Focus is on “immersive”, “participatory” and “engaging” seminar experience
 - Key will be YOUR contribution
 - My job is to guide you through the learning process and hopefully make you like thinking about networks
- Self-serving Motivation/Agenda



Syllabus



Graduate Seminar on
Complex Networks and Enterprises

Georgia Institute of Technology
ByE / MGT / CS 8803
Fall 2008

Monday, 3:00pm - 5:55 pm
Tennenbaum Institute, Technology Square, 760 Spring Street NW, Rm 129

Instructor: Rahul C. Basole, PhD
Office: Tennenbaum Institute, Technology Square, 760 Spring Street NW, Rm 125
Office Hours: By appointment
Telephone: (404) 385-6269
Email: rahul.basole@t.gatech.edu
Course URL: <http://www.ti.gatech.edu/basole/seminar/networks/>

Course Overview

This seminar is designed as an introduction to complex networks in organizational contexts, building on seminal readings from multi-disciplinary (e.g. management, engineering, computer science, and policy) perspectives. The objective of this seminar is to familiarize students with the theory, research and methodological issues connected with network analysis in the organizational sciences. The seminar will explore "networks" in topical areas such as innovation, knowledge/collaboration, new product/service development, supply chains, business ecosystems, and entrepreneurship, investigate the role of information and communication technologies (ICT) in complex networks, and examine examples from a diverse set of industries (e.g. high-tech, manufacturing, telecommunications, health and life sciences, etc.). Upon completion of the seminar, students should have a good grasp of complex network concepts and methods, and be able to use them to conduct research. An emphasis is placed on applying complex network thinking in the development of each student's own individual research interests. The seminar will include guest lectures by leading faculty and practitioners.

Course Format

This course is organized as a research seminar. This means that you are primarily responsible for discussing the readings. You are expected to do all of the readings for each session and to be prepared to discuss and comment on the readings. The underlying notion of the class is interaction, not passivity. Consequently, class participation will be considered significantly in grading.

The course focuses on management, engineering, and computer science perspectives of network analysis. The goal is to provide students an appreciation for network and complex systems thinking in the organizational and management science. Readings will consist of a range of theoretical, empirical, case study, and practitioner articles. An EndNote reference library of all required and suggested readings can be downloaded from the course webpage. Throughout the semester, we will have several guest speakers who will provide practical relevance and provide their views on network-related topics.

- Course Overview
- Course Format
- Course Requirements
- Readings and Conversation Starters
- Discussion Leadership
- Research Paper
- Attendance
- Grading
- Honor Code
- Course Schedule
- Guest Speakers

Framework for Discussing and Integrate Readings

- **Research Question**
 - What is the research question of this article?
- **Theory Base**
 - What theory was used? What domain did it come from?
- **Research Data and Method**
 - What type of data and research method was used? Is it multi-method?
 - Where did the data come from? How was it analyzed?
- **Network Elements**
 - What are the nodes? What are the links? What flows (e.g. knowledge, money, physical goods)?
 - How do you interpret network metrics in the context of the study?
 - Map, Map, Map
- **Contribution**
 - What is the main contribution?
 - What were the most important insights you obtained from the reading?
 - What are the strengths and weaknesses of each article?
- **Extension**
 - What are the limitations? How can it be extended?
- **Big Picture**
 - What do you know now that you didn't know before?
 - What do you now think about differently?
 - How do the articles relate to each other and to others read in previous weeks?

Research Paper

- Exploration of a “network” issue of interest to the student’s research.
 - The TI focus is on Future Media, Global Manufacturing, Healthcare, and Energy
- Topics may include*
 - A network analysis of a particular enterprise, industry, or ecosystem
 - A critical literature review of some specific aspect of organizational network research
 - A theory development paper, proposing a new theoretical direction and specifying a research agenda for complex networks and enterprises.
- Timeline
 - Topic Proposal (June 23)
 - Overview and Outline of the Proposal (July 14)
 - Presentation (August 4)
 - Research Paper (August 6)

Discussion Leadership Sign-Up

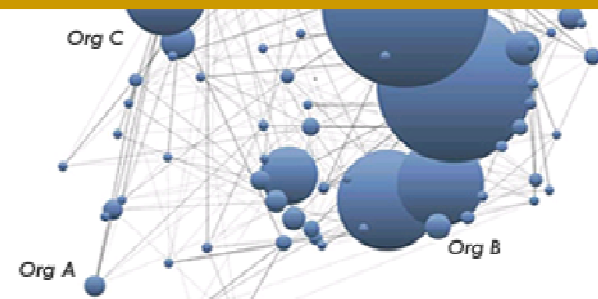


Session	Date	Topic	Name
1	May 19	Introduction and Overview	
2	May 26	<i>No Class</i>	----
3	Jun. 2	Fundamentals of Network Analysis and Visualization	
4	Jun. 9	Value Networks and Business Ecosystems	
5	Jun. 16	<i>No Class (Project Catch-Up)</i>	----
6	Jun. 23	Knowledge and Collaboration Networks	
7	Jun. 30	Innovation Networks I	
8	Jul. 7	Innovation Networks II	
9	Jul. 14	Networks in Operations Management	----
10	Jul. 21	Networks and Transformation	
11	Jul. 28	<i>No Class (Project Catch-Up)</i>	----
16	Aug. 4	Research Presentation and Concluding Overview	

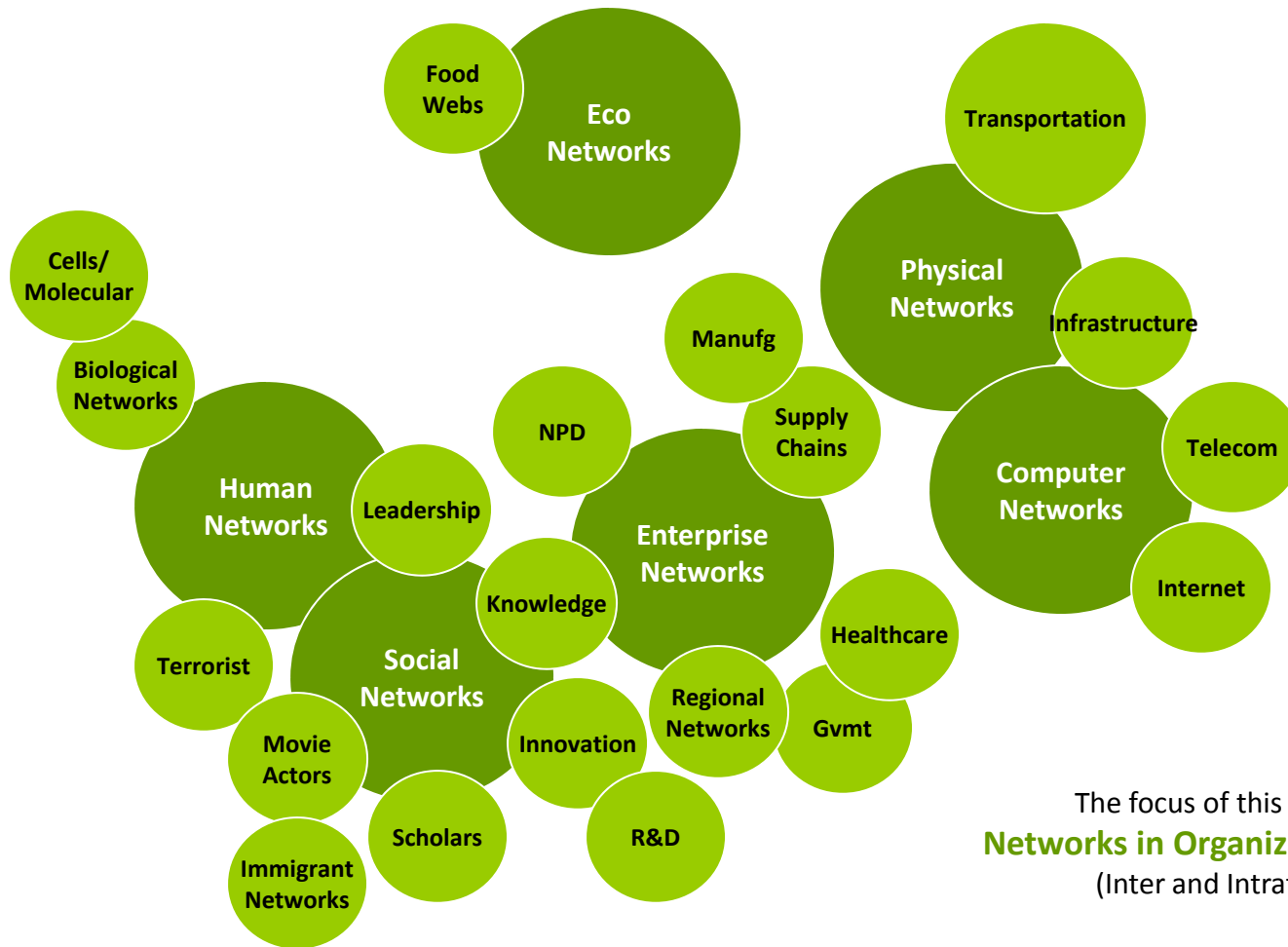
Complex Networks and Enterprises

Session 1 | Introduction to Networks and Enterprises

<http://www.ti.gatech.edu/basole/seminar/networks/>



Networks are Everywhere



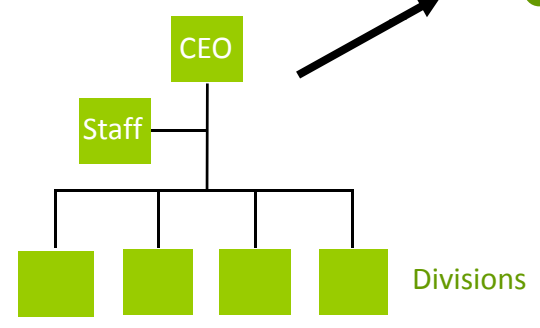
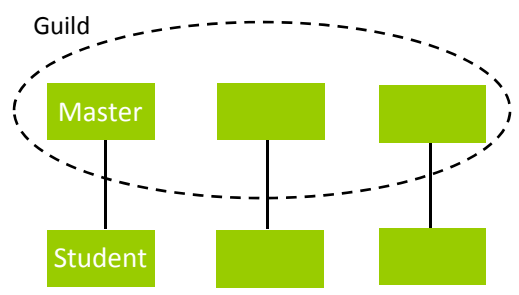
The focus of this course is on **Networks in Organizational Contexts**
(Inter and Intrafirm Level)

Why Study Networks and Enterprises?

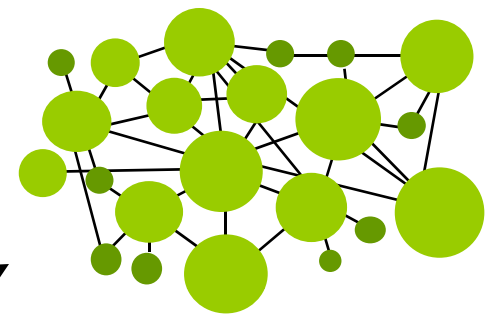
- Networked Economy
 - Alliances
 - Joint Ventures
 - Partnerships

- R&D and Innovation
 - “Not invented here”

- Globalization



'Stand Alone' Model:
 - Economies of Scale
 - Optimize Assets



Networked model:
 - Access to knowledge
 - Co-development
 - Leverage knowledge
 - Focus on core competences
 - Learn and innovate

Organizational Models are Transforming from “Stand Alone” to “Networked”

The Network Perspective: Interfirm Example

- Two firms in the same market. Which firm performs better (say, is more innovative): A or B?

A **B**
● ●

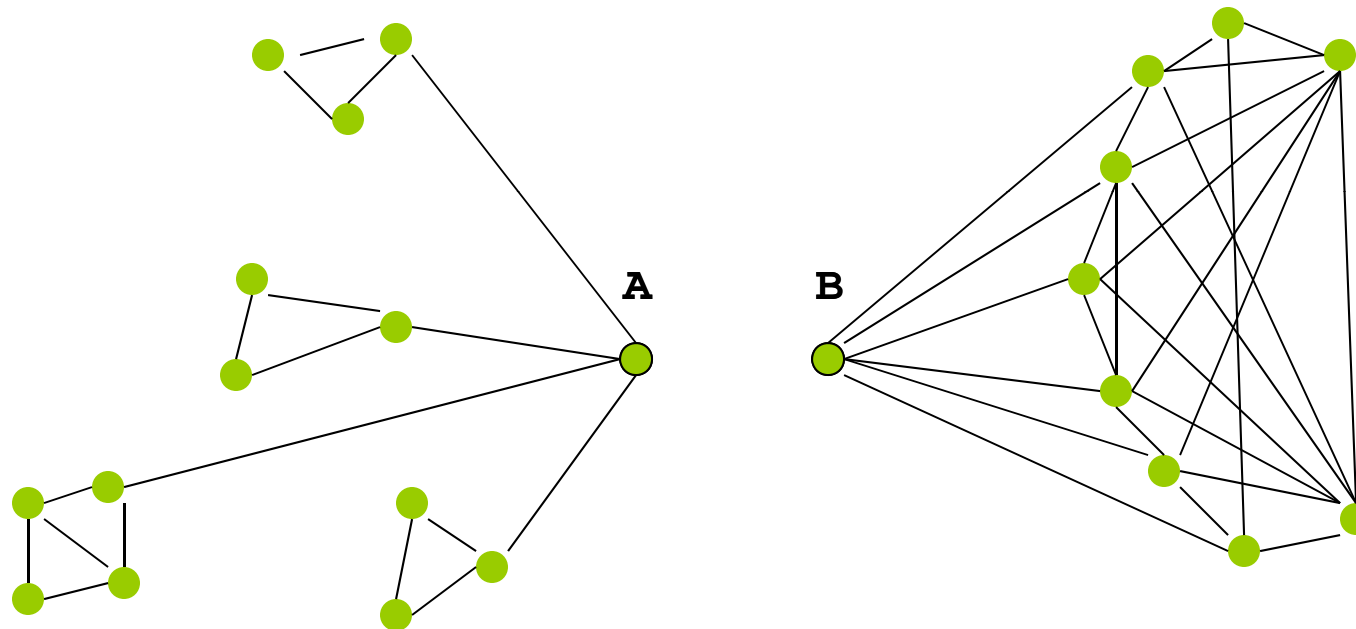
This depends on:

- Cost Effectiveness
- Organizational Structure
- Corporate Culture
- Flexibility
- Supply Chain Management
- ...

Source: Snijders, Matzat, and Rooks (2007)

The Network Perspective: Interfirm Example

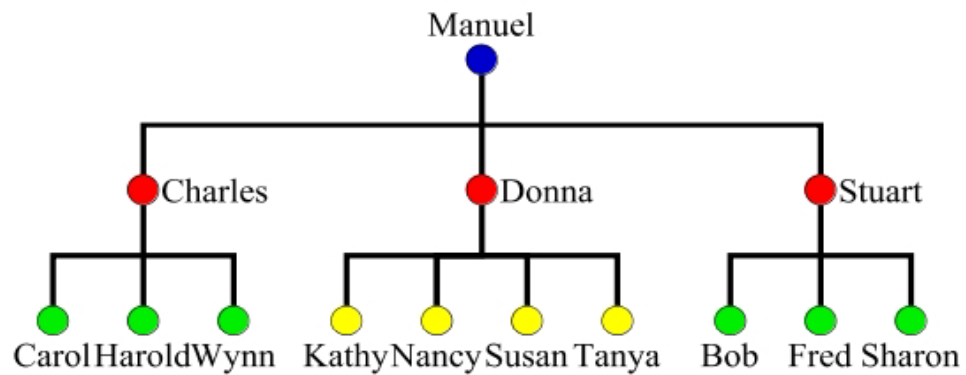
- Two firms in the same market. Which firm performs better (say, is more innovative): A or B?



and ... on the structure of the network

The Network Perspective: Intra-firm Example

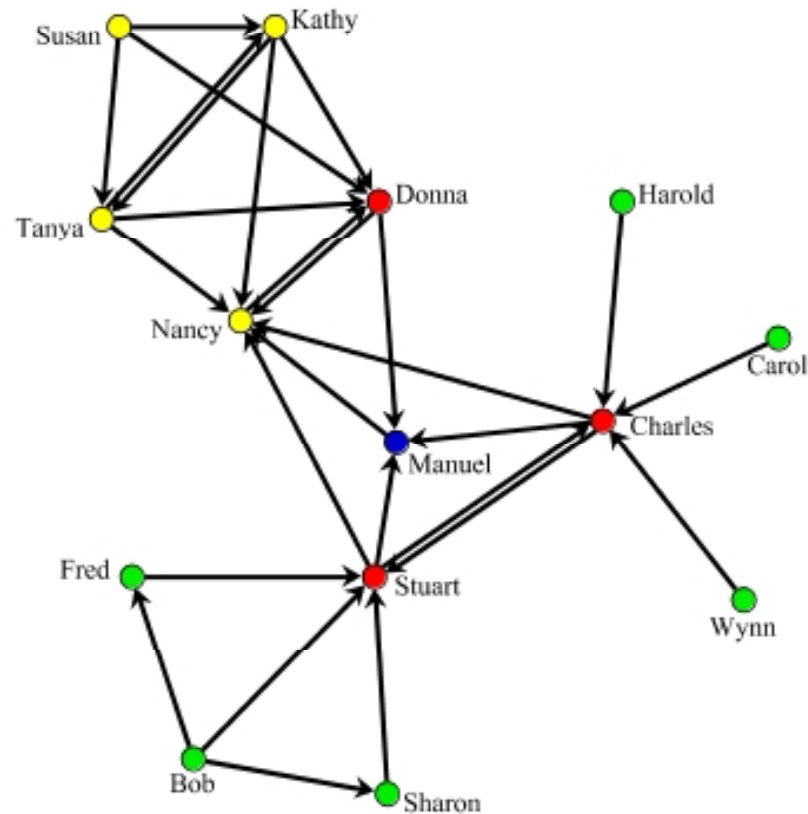
- Organizations as Networks: Org Chart shows formal ties...



Source: Brandes, Raab and Wagner (2001)

The Network Perspective: Intra-firm Example

- ... but the graph of *actual* connections is really different



Source: Brandes, Raab and Wagner (2001)

What makes the Study of Networks Interesting?

- **Structure (or Statics)**

- Emphasis on structural properties (such as size, diameter, connectivity, degree distribution, etc.)
- Examine statistics across many networks
- The term topology is also used to refer to structure
- Structure can reveal:
 - Community
 - “Important” vertices, centrality, etc.
 - Robustness and vulnerabilities

- **Dynamics**

- Emphasis on what happens on networks
- Examples:
 - Innovation Diffusion
 - Spread of Wealth in Economic Network

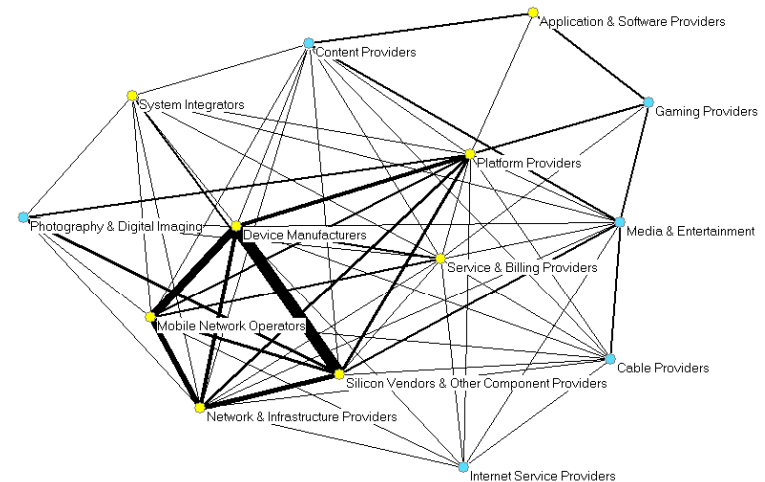
- *Statics and dynamics often closely linked, e.g. rate of knowledge diffusion (dynamics) depends critically on network connectivity and topology (structure)*

- **Formation and Evolution**

- Why does a particular structure emerge?
- Plausible processes for network formation?

What is a Network?

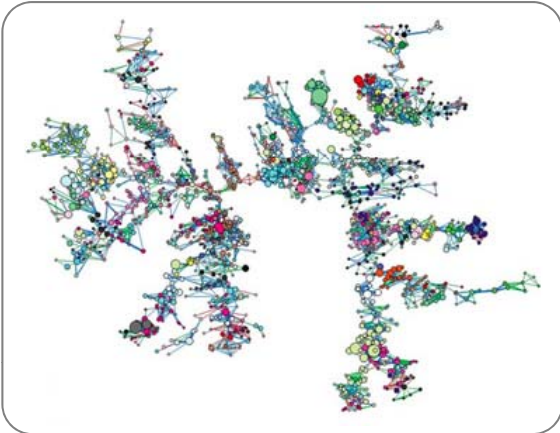
- A network (or graph) contains a set of nodes (or vertices, actors, objects) and a mapping of links (or ties, relations, edges) between the nodes
- Most Simple Network: Two Nodes, One Link
- Links can have Attributes
 - Directed or Undirected
 - Weights
- Nodes can have Attributes
 - Quantitative
 - Qualitative



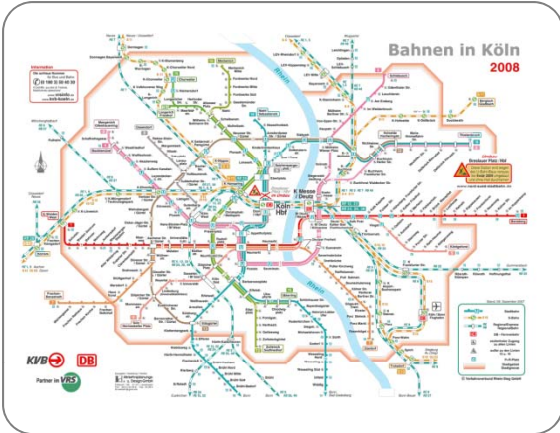
Some Basic Network Properties (more detail later)

- Size
 - Number of nodes
- Density
 - Number of ties that are present the amount of ties that could be present
- Out-degree
 - Sum of connections from an actor to others
- In-degree
 - Sum of connections to an actor
- Geodesic distance
 - The number of relations in the shortest possible walk from one actor to another
- Closeness centrality
 - Distance of one actor to all others in the network
- Betweenness centrality
 - Number that represents how frequently an actor is between other actors' geodesic paths
- Cliques
 - Sub-set of actors
 - More closely tied to each other than to actors who are not part of the sub-set
- Cutpoint and Brokerage
- Bridges

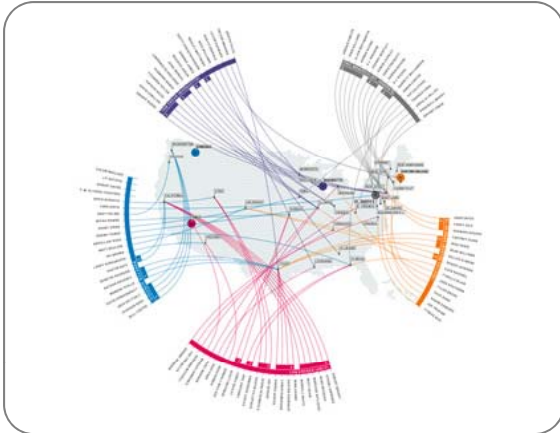
Complex Networks and Visualization



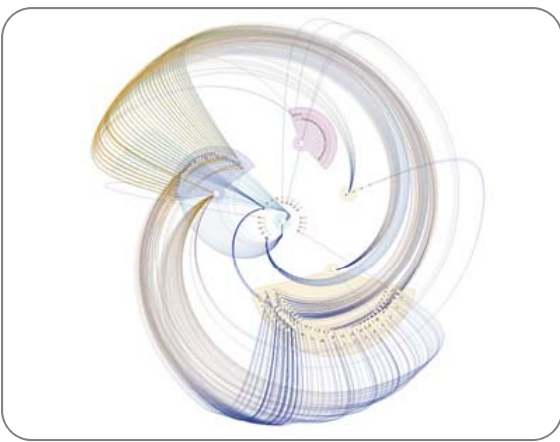
Silicon Valley's Inventor Network (2006)



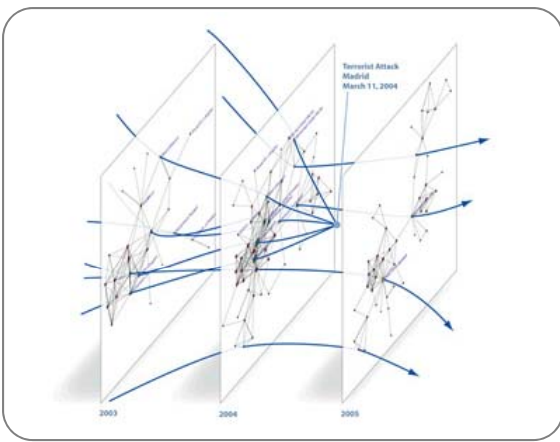
Cologne Transportation Network (2008)



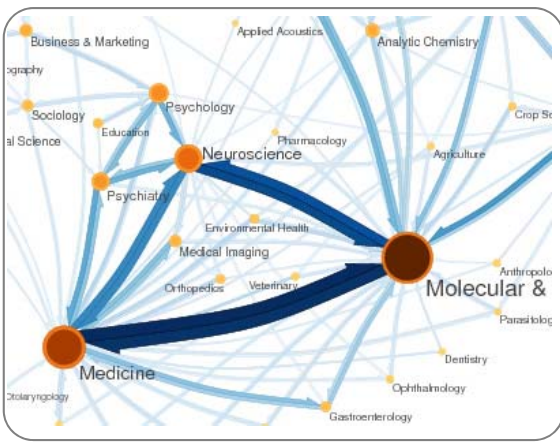
ESPN Map of Basketball Talent (2007)



Website Traffic Map (2004)



Terrorist Network for Madrid Bombing (2007)



Map of Science (2007)

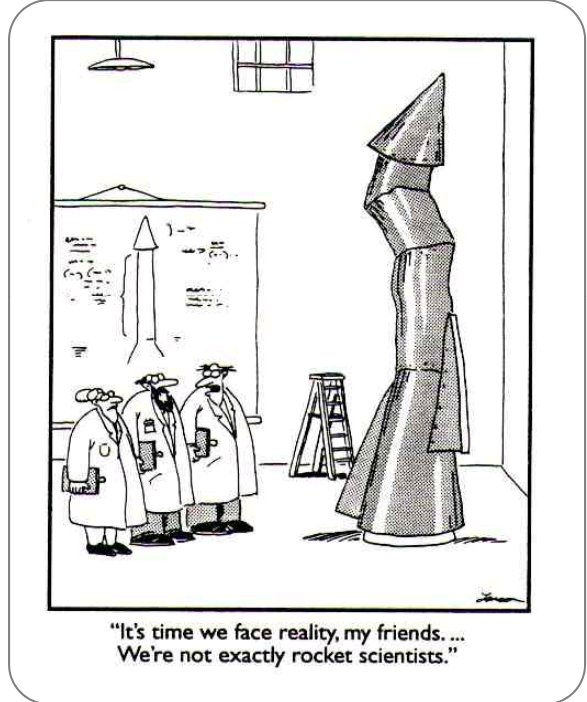
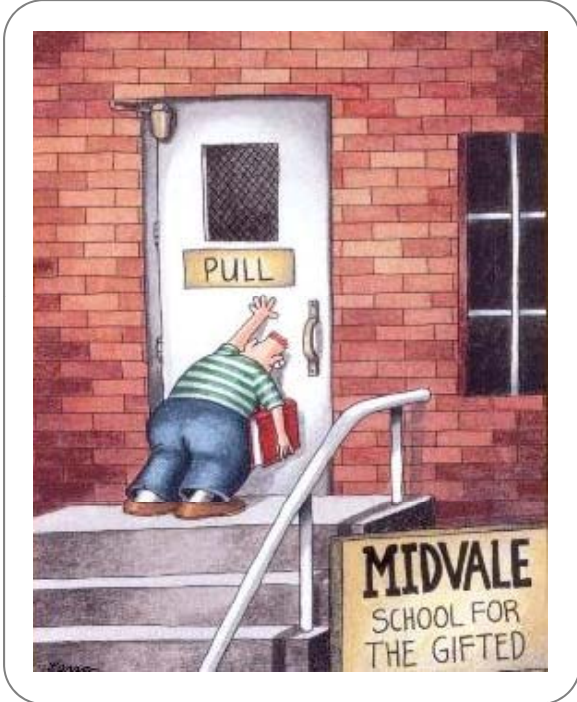
What core skills I want you to gain ...

- Seeing the “Network”
- Mapping the “Network”
- Analyzing the “Network”

Assignment for Next Time

- May 26
 - Send me your top three choices (in order of preference) for Class Discussion Leadership by May 26
- June 2
 - Read Assignments for Today and Session 3
 - Download Pajek (or UCINET)
 - Start thinking about a Research Topic!

Some Parting Thoughts



Thank you.

<http://www.ti.gatech.edu/basole/seminar/networks/>

