### Type of Analysis vs. Level of Analysis

<table>
<thead>
<tr>
<th>Type of Analysis/Profiling</th>
<th>Micro/Individual (1-100 records)</th>
<th>Meso/Local (101–10,000 records)</th>
<th>Macro/Global (10,000 &lt; records)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistical Analysis/Profiling</td>
<td>Individual person and their expertise profiles</td>
<td>Larger labs, centers, universities, research domains, or states</td>
<td>All of NSF, all of science</td>
</tr>
<tr>
<td>Temporal Analysis (When)</td>
<td>Funding portfolio of one individual</td>
<td>Mapping topic bursts in 20 years of PNAS</td>
<td>113 Years of physics research</td>
</tr>
<tr>
<td>Geospatial Analysis (Where)</td>
<td>Career trajectory of one individual</td>
<td>Mapping an intellectual landscape</td>
<td>PNAS publications</td>
</tr>
<tr>
<td>Topical Analysis (What)</td>
<td></td>
<td>Knowledge flows in chemistry research</td>
<td></td>
</tr>
<tr>
<td>Network Analysis (With Whom?)</td>
<td>NSF or NIH network of one individual</td>
<td></td>
<td>NIH’s core competency</td>
</tr>
</tbody>
</table>

### Information Visualization MOOC

**Unit 1: Visualization Framework & Workflow Design**

- **Visualization Framework**
  - Type of Analysis (temporal ... network)
  - Level of Analysis (micro ... macro)

[http://ivmooc.cns.iu.edu](http://ivmooc.cns.iu.edu)
How to Classify Different Visualizations?

By

• User insight needs?
• User task types?

• Data to be visualized?
• Data transformation?

• Visualization technique?
• Visual mapping transformation?
• Interaction techniques?

• Or?
Different Question Types

Find your way
Descriptive & Predictive Models
Find collaborators, friends
Identify trends

Terabytes of data

Different Levels of Abstraction/Analysis

Macro/Global
Population Level

Meso/Local
Group Level

Micro
Individual Level
### Type of Analysis vs. Level of Analysis

<table>
<thead>
<tr>
<th></th>
<th>Micro/Individual (1-100 records)</th>
<th>Meso/Local (101–10,000 records)</th>
<th>Macro/Global (10,000 &lt; records)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Statistical Analysis/Profiling</strong></td>
<td>Individual person and their expertise profiles</td>
<td>Larger labs, centers, universities, research domains, or states</td>
<td>All of NSF, all of USA, all of science.</td>
</tr>
<tr>
<td><strong>Temporal Analysis (When)</strong></td>
<td>Funding portfolio of one individual</td>
<td>Mapping topic bursts in 20 years of PNAS</td>
<td>113 years of physics research</td>
</tr>
<tr>
<td><strong>Geospatial Analysis (Where)</strong></td>
<td>Career trajectory of one individual</td>
<td>Mapping a state’s intellectual landscape</td>
<td>PNAS publications</td>
</tr>
<tr>
<td><strong>Topical Analysis (What)</strong></td>
<td>Base knowledge from which one grant draws.</td>
<td>Knowledge flows in chemistry research</td>
<td>VxOrd/Topic maps of NIH funding</td>
</tr>
<tr>
<td><strong>Network Analysis (With Whom?)</strong></td>
<td>NSF Co-PI network of one individual</td>
<td>Co-author network</td>
<td>NIH’s core competency</td>
</tr>
</tbody>
</table>
Mapping Indiana’s Intellectual Space

**Geospatial/Network Analysis**
2001-2006, BioMed, IN Scope
Identify:
- Pockets of innovation
- Pathways from ideas to products
- Interplay of industry and academia

**Academic-Industry collaborations and knowledge diffusion**

Mapping Topic Bursts

Co-word space of the top-50 most frequent and bursty words used in the top-10% most highly cited PNAS publications in 1982-2001.

Spatio-Temporal Information Production and Consumption of Major U.S. Research Institutions
Börner, Penumarthy, Meiss, & Ke.

Research questions:
1. Does space still matter in the Internet age?
2. Does one still have to study and work at major research institutions in order to have access to high-quality data and high-quality research?
3. Does the Internet lead to more global citation patterns—i.e., more citation links between papers produced at geographically distant research institutions?

Contributions:
- Answer to Qs 1 + 2 is YES.
- Answer to Qs 3 is NO.
- Novel approach to analyzing the dual role of institutions as information producers and consumers and to study and visualize the diffusion of information among them.

Individual Co-PI Network
Ke & Börner. 2006.

Temporal/Network Analysis
2001-2006, US, InfoVis Scope
Evolving project-PI networks
Ke, Visvanath & Börner. 2004. Won 1st prize at the IEEE InfoVis Contest.
Studying the Emerging Global Brain: Analyzing and Visualizing the Impact of Co-Authorship Teams


Research question:
• Is science driven by prolific single experts or by high-impact co-authorship teams?

Contributions:
• New approach to allocate citational credit.
• Novel weighted graph representation.
• Visualization of the growth of weighted co-author network.
• Centrality measures to identify author impact.
• Global statistical analysis of paper production and citations in correlation with co-authorship team size over time.
• Local, author-centered entropy measure.

113 Years of Physical Review

http://scimaps.org/dev/map_detail.php?map_id=171
Herr II, Duhon, Hardy, Penumarthy & Börner.
Science Maps: Identifying Core Competency
Boyack, Börner & Klavans. 2007.

- Uses combined SCI/SSCI from 2002
  - 1.07M papers, 24.5M references, 7,300 journals
  - Bibliographic coupling of papers, aggregated to journals
- Initial ordination and clustering of journals gave 671 clusters
- Coupling counts were reaggregated at the journal-cluster level to calculate the
  - (x,y) positions for each journal cluster
  - by association, (x,y) positions for each journal

Science Maps: Identifying Core Competency
Boyack, Börner & Klavans. 2007.

Funding patterns of the US Department of Energy (DOE)
Science Maps: Identifying Core Competency
Boyack, Börner & Klavans. 2007.

Funding Patterns of the National Science Foundation (NSF)

Science Maps: Identifying Core Competency
Boyack, Börner & Klavans. 2007.

Funding Patterns of the National Institutes of Health (NIH)
Science Maps: Identifying Core Competency  
Boyack, Börner & Klavans. 2007.

Funding Patterns of the National Institutes of Health (NIH)

**Topic/Network Analysis**  
2002, World, Science/Social Science & DOE/NSF/NIH Funding Scope  
Map main structure of science and funding profiles

Mapping Transdisciplinary Tobacco Use Research Centers Publications  
Compare R01 investigator-based funding with TTURC Center awards in terms of number of publications and evolving co-author networks.  
Zoss & Börner. Forthcoming.  
Supported by NIH/NCI Contract HHSN261200800812

**Network Analysis**  
1998-2009, US, NIH Data on Tobacco research funding  
Comparison of co-author networks
**Research Collaborations by the Chinese Academy of Sciences**

*Huang, Duhon, Hardy & Börner*

---

### Geospatial Analysis

*World, Chinese Academy of Science Collaboration and knowledge diffusion via co-author networks*

---

#### Type of Analysis vs. Level of Analysis

<table>
<thead>
<tr>
<th>Type of Analysis</th>
<th>Micro/Individual (1-100 records)</th>
<th>Meso/Local (101–10,000 records)</th>
<th>Macro/Global (10,000 &lt; records)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistical</td>
<td>Individual person and their expertise profiles</td>
<td>Larger labs, centers, universities, research domains, or states</td>
<td>All of NSF of all of USA, all of science</td>
</tr>
<tr>
<td>Analysis/Profiling</td>
<td><strong>Temporal Analysis (When)</strong></td>
<td>Funding portfolio of one individual</td>
<td>113 Years of physics research</td>
</tr>
<tr>
<td></td>
<td><strong>Geospatial Analysis (Where)</strong></td>
<td>Career trajectory of one individual</td>
<td>PNAS publications</td>
</tr>
<tr>
<td></td>
<td><strong>Topical Analysis (What)</strong></td>
<td>Knowledge flows in chemistry research</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Network Analysis (With Whom?)</strong></td>
<td>NSF network of one</td>
<td>NIH's core competency</td>
</tr>
</tbody>
</table>