Plug-and-Play Macroscopes

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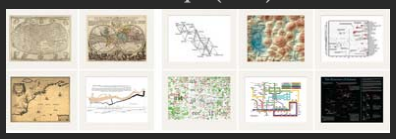
Beyond Open Access: The Wiki-era, Translational Medicine, and Scientometrics
3rd European Conference on Scientific Publishing in Biomedicine and Medicine (ECSP3)
Leiden University Medical Center, The Netherlands

May 28, 2010

Mapping Science Exhibit – 10 Iterations in 10 years

http://scimaps.org

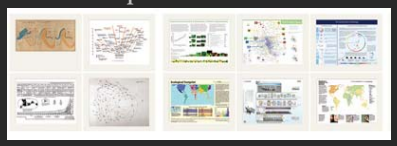
The Power of Maps (2005)



The Power of Reference Systems (2006)

The Power of Forecasts (2007)

Science Maps for Economic Decision Makers (2008)



Science Maps for Science Policy Makers (2009)
Science Maps for Scholars (2010)
Science Maps as Visual Interfaces to Digital Libraries (2011)
Science Maps for Kids (2012)
Science Forecasts (2013)

How to Lie with Science Maps (2014)

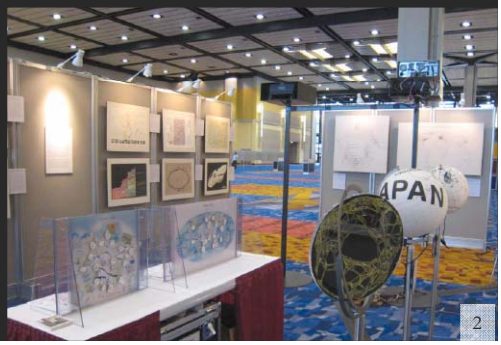
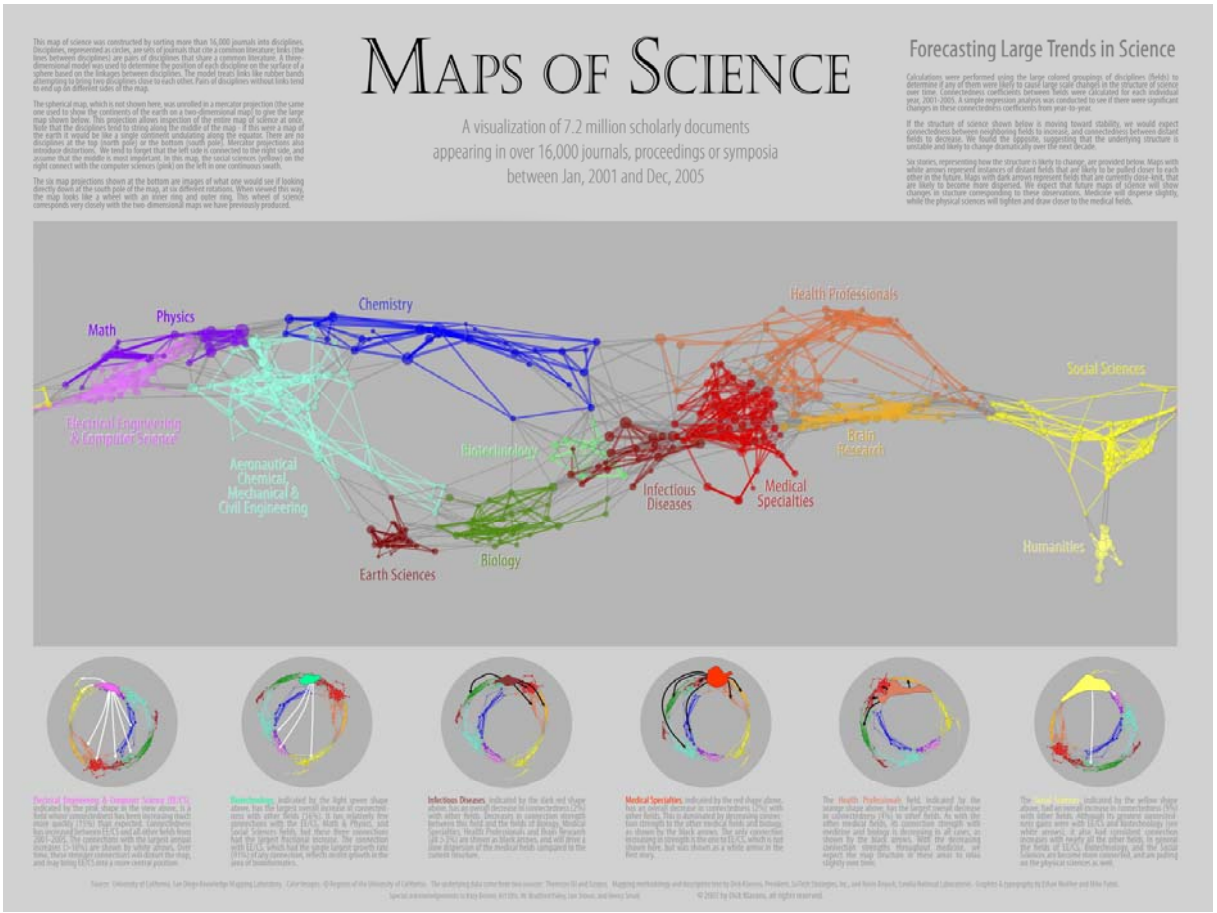
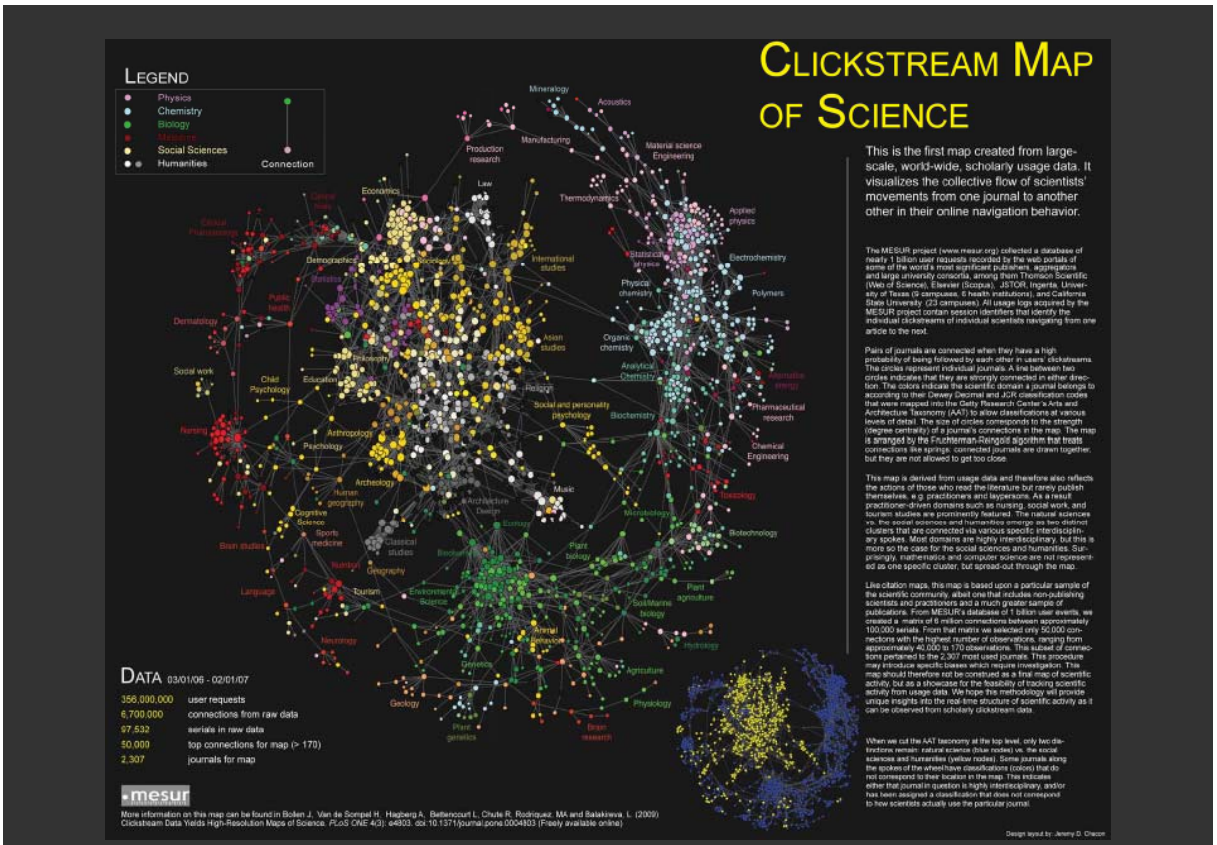
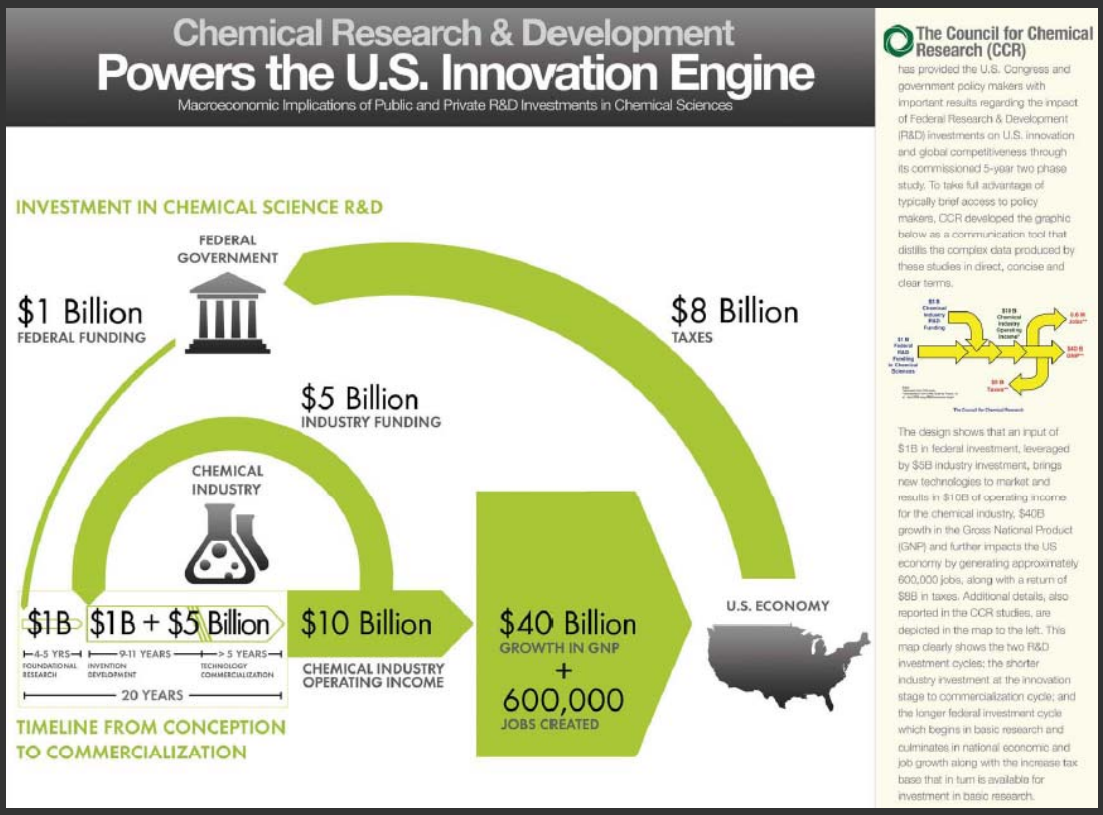


Exhibit has been shown in 72 venues on four continents. Currently at
- NSF, 10th Floor, 4201 Wilson Boulevard, Arlington, VA
- Wallenberg Hall, Stanford University, CA
- Center of Advanced European Studies and Research, Bonn, Germany
- Science Train, Germany.





Bollen, Johan, Herbert Van de Sompel, Aric Hagberg, Luis M.A. Bettencourt, Ryan Chute, Marko A. Rodriquez, Lyudmila Balakireva. 2008. A Clickstream Map of Science.



Council for Chemical Research. 2009. Chemical R&D Powers the U.S. Innovation Engine. Washington, DC. Courtesy of the Council for Chemical Research.

Debut of 5th Iteration of Mapping Science Exhibit at MEDIA X was on May 18, 2009 at Wallenberg Hall, Stanford University, *http://mediax.stanford.edu*, *http://scaleindependentthought.typepad.com/photos/scimaps*

Science Maps in "Expedition Zukunft" science train visiting 62 cities in 7 months
12 coaches, 300 m long
Opening was on April 23rd, 2009 by German Chancellor Merkel
http://www.expedition-zukunft.de

The Changing Scientific Landscape

Star Scientist -> Research Teams: In former times, science was driven by key scientists. Today, science is driven by effectively collaborating co-author teams often comprising expertise from multiple disciplines and several geospatial locations (Börner, Dall'Asta, Ke, & Vespignani, 2005; Shneiderman, 2008).

Users -> Contributors: Web 2.0 technologies empower anybody to contribute to Wikipedia or to exchange images and videos via Fickr and YouTube. WikiSpecies, WikiProfessionals, or WikiProteins combine wiki and semantic technology in support of real time community annotation of scientific datasets (Mons et al., 2008).

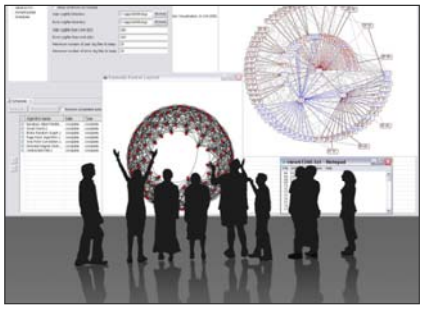
Cross-disciplinary: The best tools frequently borrow and synergistically combine methods and techniques from different disciplines of science and empower interdisciplinary and/or international teams of researchers, practitioners, or educators to fine-tune and interpret results collectively.

One Specimen -> Data Streams: Microscopes and telescopes were originally used to study one specimen at a time. Today, many researchers must make sense of massive streams of multiple types of data with different formats, dynamics, and origin.

Static Instrument -> Evolving Cyberinfrastructure (CI): The importance of hardware instruments that are rather static and expensive decreases relative to software infrastructures that are highly flexible and continuously evolving according to the needs of different sciences. Some of the most successful services and tools are decentralized increasing scalability and fault tolerance.

Microscopes, Telescopes, and Macrocopes





Just as the **microscope** empowered our naked eyes to see cells, microbes, and viruses thereby advancing the progress of biology and medicine or the **telescope** opened our minds to the immensity of the cosmos and has prepared mankind for the conquest of space, **macroscopes** promise to help us cope with another infinite: the infinitely complex. Macroscopes give us a 'vision of the whole' and help us 'synthesize'. They let us detect patterns, trends, outliers, and access details in the landscape of science. Instead of making things larger or smaller, macroscopes let us observe what is at once too great, too slow, or too complex for our eyes.

Desirable Features of Macroscopes

Core Architecture & Plugins/Division of Labor: Computer scientists need to design the standardized, modular, easy to maintain and extend "core architecture". Dataset and algorithm plugins, i.e., the "filling", are provided by those that care and know most about the data and developed the algorithms: the domain experts.

Ease of Use: As most plugin contributions and usage will come from non-computer scientists it must be possible to contribute, share, and use new plugins without writing one line of code. Users need guidance for constructing effective workflows from 100+ continuously changing plugins.

Modularity: The design of software modules with well defined functionality that can be flexibly combined helps reduce costs, makes it possible to have many contribute, and increases flexibility in tool development, augmentation, and customization.

Standardization: Adoption of (industry) standards speeds up development as existing code can be leveraged. It helps pool resources, supports interoperability, but also eases the migration from research code to production code and hence the transfer of research results into industry applications and products.

Open Data and Open Code: Lets anybody check, improve, or repurpose code and eases the replication of scientific studies.

Börner, Katy (in press) Plug-and-Play Macroscopes. Communications of the ACM.

Example: Science of Science Studies

About 5-20 algorithms are involved in one single study/workflow.

DATA EXTRACTION	UNIT OF ANALYSIS	MEASURES	LAYOUT (often one code does both similarity and ordination steps)		DISPLAY
			SIMILARITY	ORDINATION	

SEARCHES
- ISI
- INSPEC
- Eng Index
- Medline
- ResearchIndex
- Patents
- etc.

BROADENING
- By citation
- By terms

COMMON CHOICES
- Journal
- Document
- Author
- Term

COUNTS/FREQUENCIES
- Attributes (e.g. terms)
- Author citations
- Co-citations
- By year

THRESHOLDS
- By counts

SCALAR (unit by unit matrix)
- Direct citation
- Co-citation
- Combined linkage
- Co-word / co-term
- Co-classification

VECTOR (unit by attribute matrix)
- Vector space model (words/terms)
- Latent Semantic Analysis (words/terms) incl. Singular Value Decomp (SVD)

CORRELATION (if desired)
- Pearson's R on any of above

DIMENSIONALITY REDUCTION
- Eigenvector/ Eigenvalue solutions
- Factor Analysis (FA) and Principal Components Analysis (PCA)
- Multi-dimensional scaling (MDS)
- LSA, Topics
- Pathfinder networks (PFNet)
- Self-organizing maps (SOM) includes SOM_ET-maps, etc.

CLUSTER ANALYSIS

SCALAR
- Triangulation
- Force-directed placement (FDP)

INTERACTION
- Browse
- Pan
- Zoom
- Filter
- Query
- Detail on demand

ANALYSIS

Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003) Visualizing Knowledge Domains. ARIST, pp. 179-255.

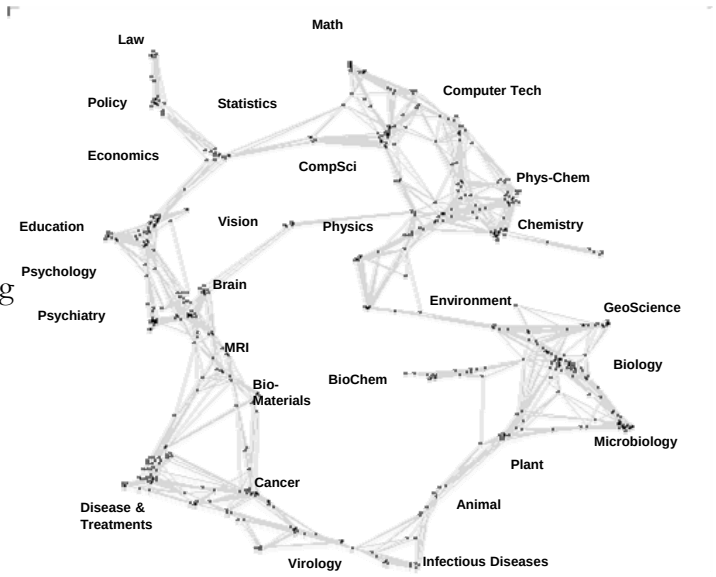
Domain has about 300 core researchers, 10 key data sources, 20 common tools.

Approaches/algorithms from network science, social science, political science, economics, physics, information science, webometrics, etc. are highly relevant and new ones become available every day.

2002 Base Map of Science

Kevin W. Boyack, Katy Börner, & Richard Klavans (2007). Mapping the Structure and Evolution of Chemistry Research. 11th International Conference on Scientometrics and Informetrics. pp. 112-123.

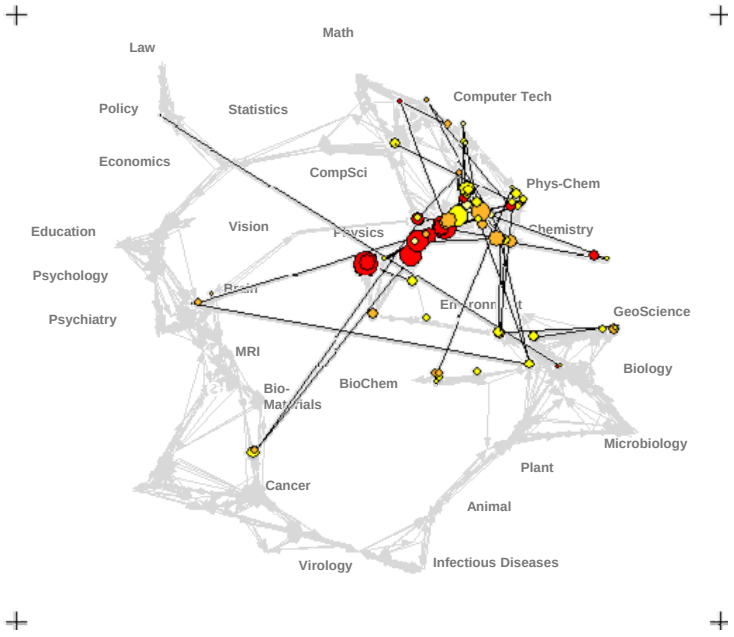
- Uses combined SCI/SSCI from 2002
  - 1.07M papers, 24.5M references, 7,300 journals
  - Bibliographic coupling of papers, aggregated to journals
- Initial ordination and clustering of journals gave 671 clusters
- Coupling counts were reaggregated at the journal cluster level to calculate the
  - (x,y)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



Science map applications: Identifying core competency

Kevin W. Boyack, Katy Börner, & Richard Klavans (2007).

Funding patterns of the US Department of Energy (DOE)



Science map applications: Identifying core competency

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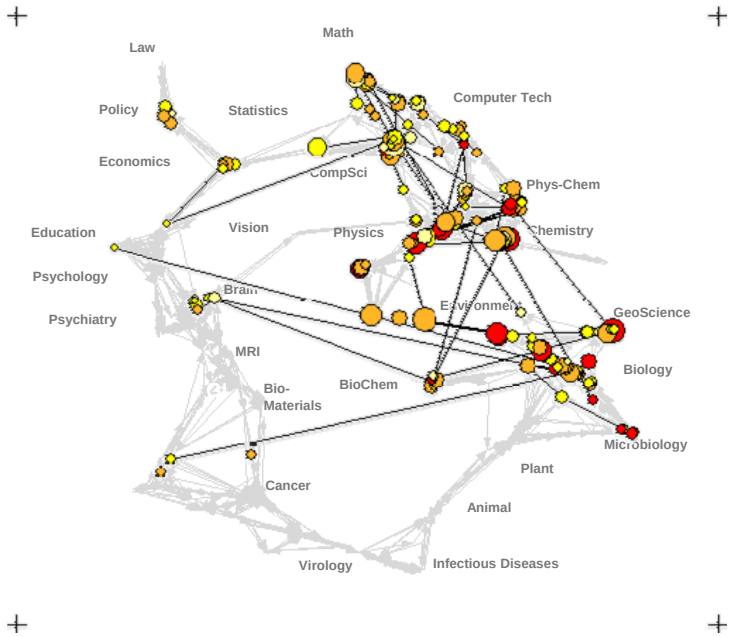
Funding Patterns of the National Science Foundation (NSF)



Science map applications: Identifying core competency

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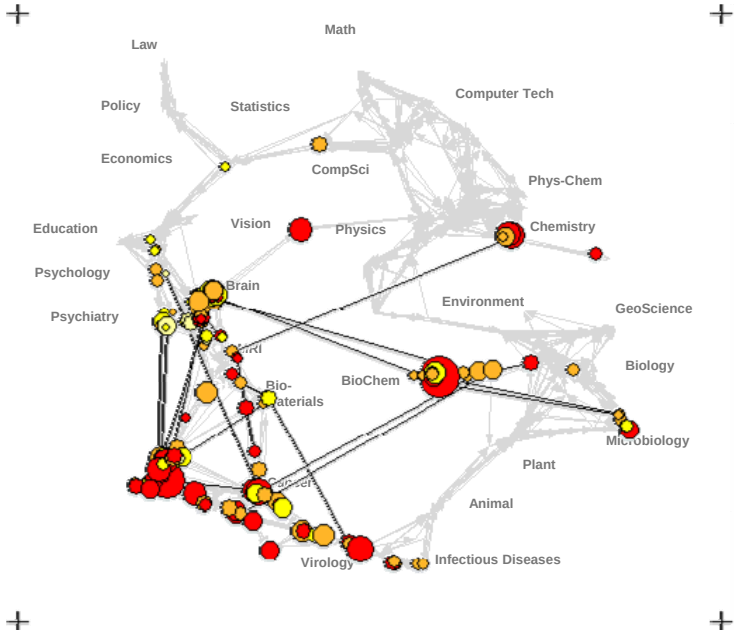
Funding Patterns of the National Institutes of Health (NIH)



Macroscope Design

Custom Tools for Different Scientific Communities

Information Visualization Cyberinfrastructure
http://iv.slis.indiana.edu

Network Workbench Tool + Community Wiki
http://nwb.slis.indiana.edu

Science of Science (Sci²) Tool and Portal
http://sci.slis.indiana.edu

Epidemics Cyberinfrastructure
http://epic.slis.indiana.edu/

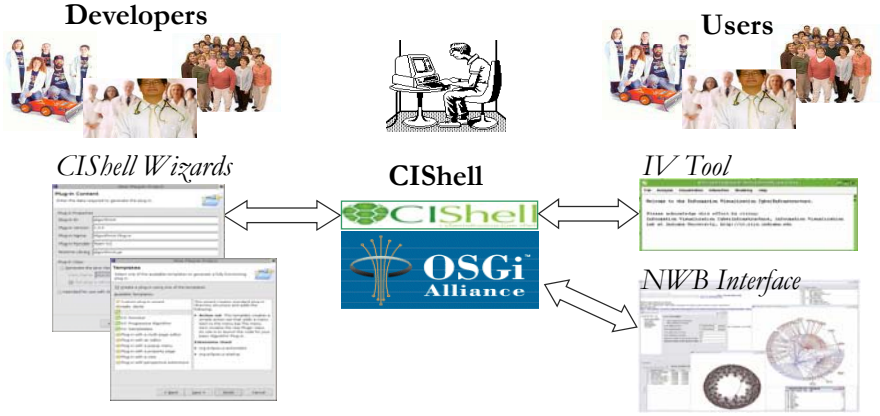
180+ Algorithm Plugins and Branded GUIs
+
Core Architecture

Open Services Gateway Initiative (OSGi) Framework.
http://orgi.org

Cyberinfrastructure Shell (CIShell)
http://cishell.org

Cyberinfrastructure Shell (CIShell)
http://cishell.org

- CIShell is an open source software specification for the integration and utilization of datasets, algorithms, and tools.
- It extends the Open Services Gateway Initiative (OSGi) (http://www.osgi.org), a standardized, component oriented, computing environment for networked services widely used in industry since 10 years.
- Specifically, CIShell provides "sockets" into which existing and new datasets, algorithms, and tools can be plugged using a wizard-driven process.



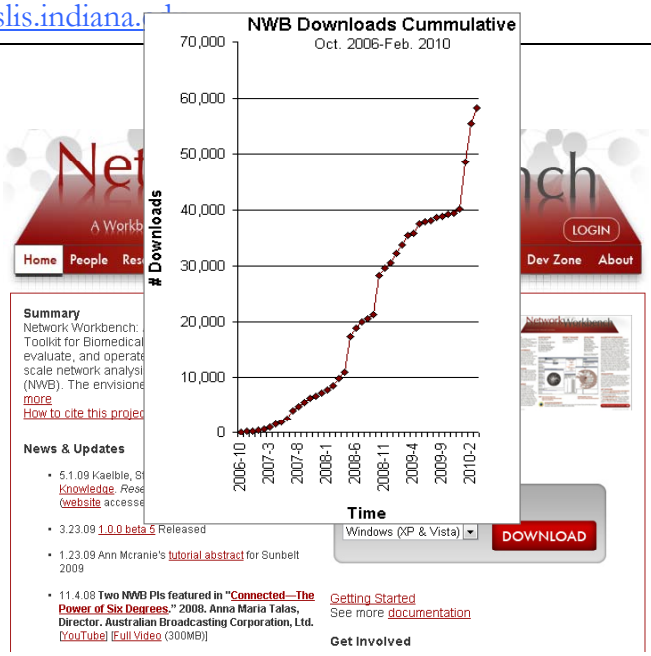
Network Workbench Tool
http://nwb.slis.indiana.

The Network Workbench (NWB) tool supports researchers, educators, and practitioners interested in the study of biomedical, social and behavioral science, physics, and other networks.

In February 2009, the tool provides more 169 plugins that support the preprocessing, analysis, modeling, and visualization of networks.

More than 50 of these plugins can be applied or were specifically designed for S&T studies.

It has been downloaded more than 65,000 times since December 2006.



Herr II, Bruce W., Huang, Weixia (Bonnie), Penumarthy, Shashikant & Börner, Katy. (2007). Designing Highly Flexible and Usable Cyberinfrastructures for Convergence. In Bainbridge, William S. & Roco, Mihail C. (Eds.), Progress in Convergence - Technologies for Human Wellbeing (Vol. 1093, pp. 161-179), Annals of the New York Academy of Sciences, Boston, MA.

Computational Proteomics

What relationships exist between protein targets of all drugs and all disease-gene products in the human protein–protein interaction network?

Yildriim, Muhammed A., Kwan-II Goh, Michael E. Cusick, Albert-László Barabási, and Marc Vidal. (2007). Drug-target Network. Nature Biotechnology 25 no. 10: 1119-1126.

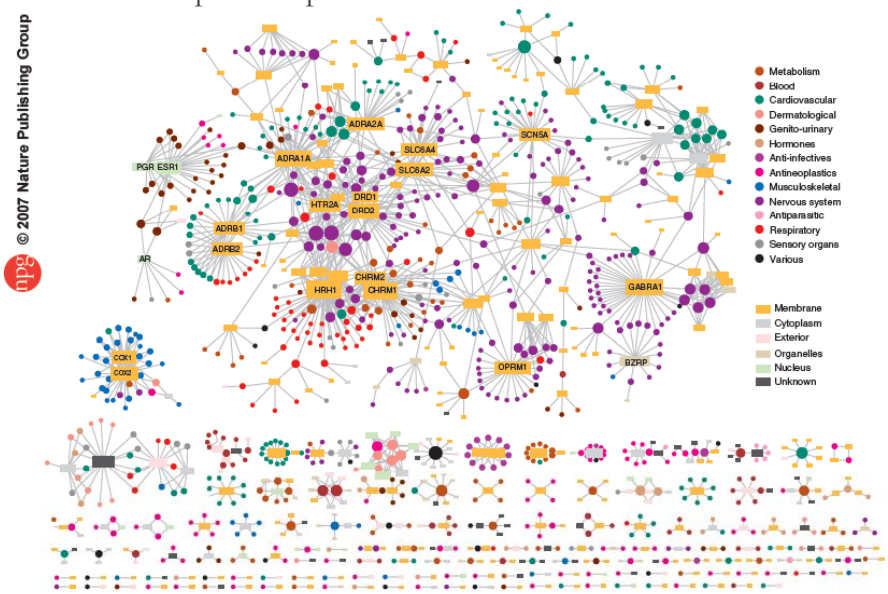


Figure 2 Drug–target network (DT network). The DT network is generated by using the known associations between FDA-approved drugs and their target proteins. Circles and rectangles correspond to drugs and target proteins, respectively. A link is placed between a drug node and a target node if the protein is a known target of that drug. The area of the drug (protein) node is proportional to the number of targets that the drug has (the number of drugs targeting the protein). Color codes are given in the legend. Drug nodes (circles) are colored according to their Anatomical Therapeutic Chemical Classification, and the target proteins (rectangular boxes) are colored according to their cellular component obtained from the Gene Ontology database.

Computational Economics

Does the type of product that a country exports matter for subsequent economic performance?

C. A. Hidalgo, B. Klinger, A.-L. Barabási, R. Hausmann (2007) The Product Space Conditions the Development of Nations. Science 317, 482 (2007).

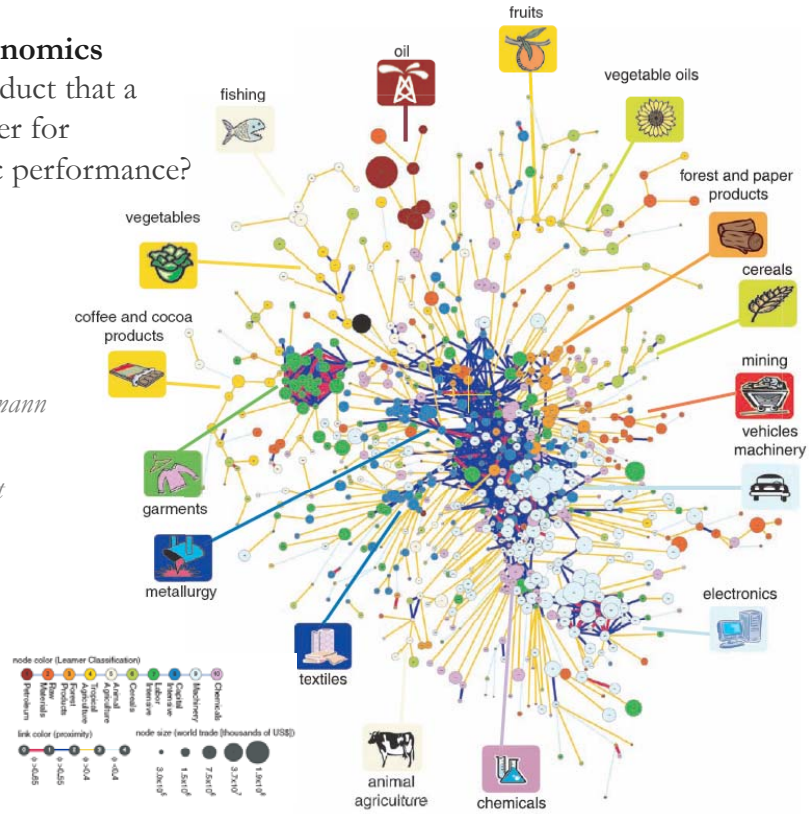
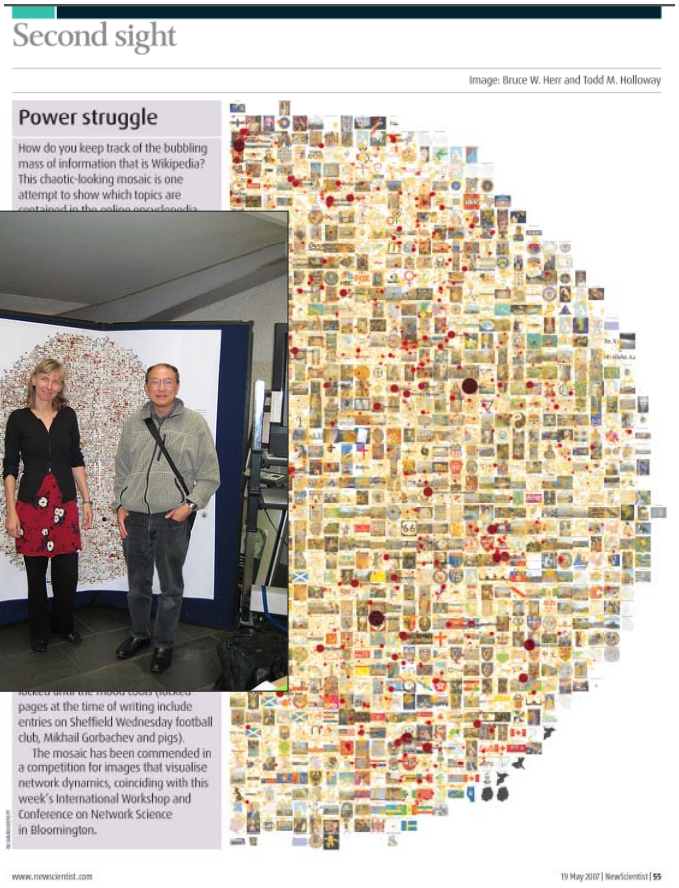
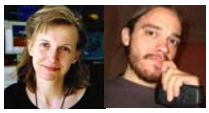


Fig. 1. The product space. **(A)** Hierarchically clustered proximity (ϕ) matrix representing the 775 SITC-4 product classes exported in the 1998–2000 period. **(B)** Network representation of the product space. Links are color coded with their proximity value. The sizes of the nodes are proportional to world trade, and their colors are chosen according to the classification introduced by Leamer.

Computational Social Science
Studying large scale social networks such as Wikipedia

Second Sight: An Emergent Mosaic of Wikipedian Activity, The NewScientist, May 19, 2007

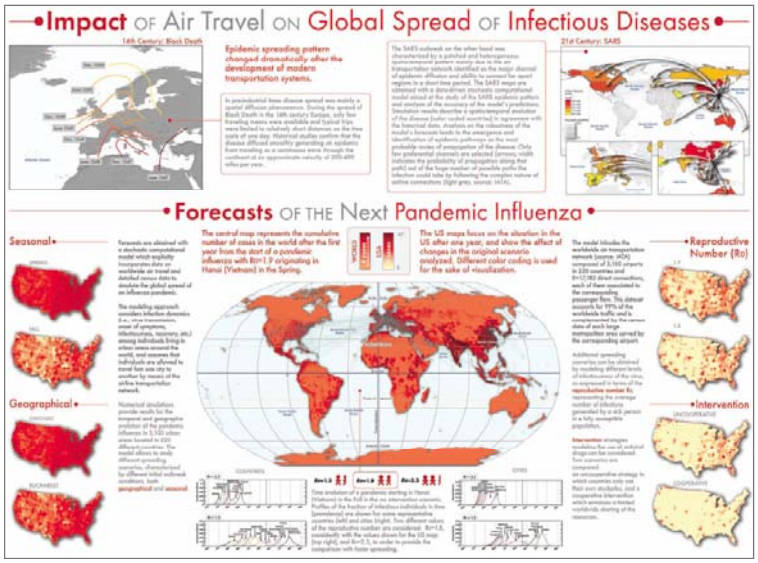




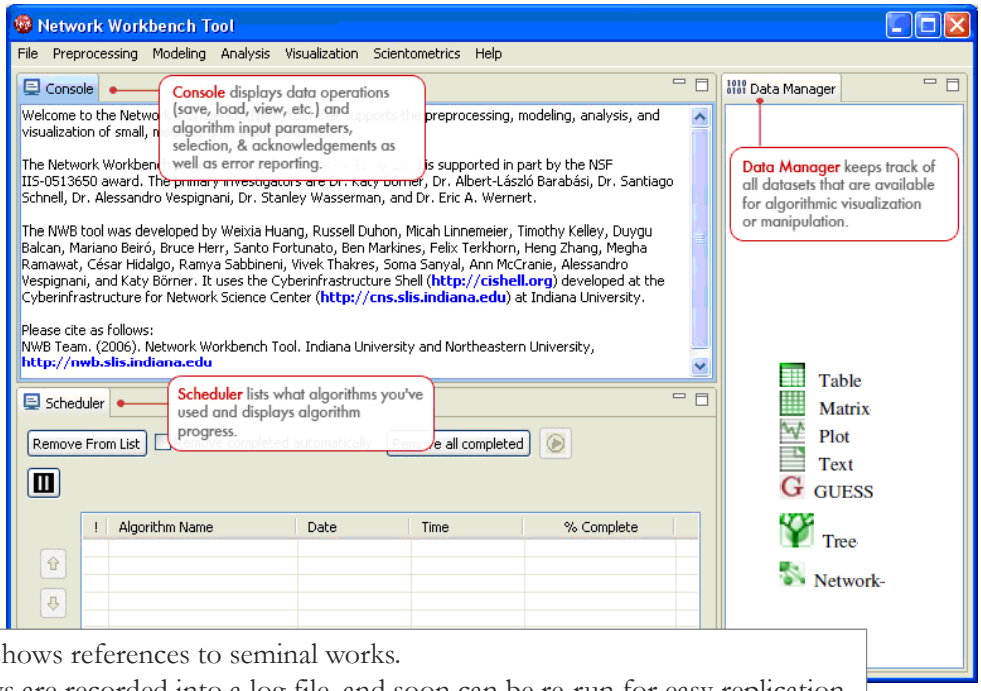
Computational Epidemics
Forecasting (and preventing the effects of) the next pandemic.

Epidemic Modeling in Complex realities, V. Colizza, A. Barrat, M. Barthelemy, A.Vespignani, Comptes Rendus Biologie, 330, 364-374 (2007).
Reaction-diffusion processes and metapopulation models in heterogeneous networks, V.Colizza, R. Pastor-Satorras, A.Vespignani, Nature Physics 3, 276-282 (2007).

Modeling the Worldwide Spread of Pandemic Influenza: Baseline Case and Containment Interventions, V. Colizza, A. Barrat, M. Barthelemy, A.-J. Valleron, A.Vespignani, PloS-Medicine 4, e13, 95-110 (2007).



NWB Tool Interface Components



Console shows references to seminal works.
Workflows are recorded into a log file, and soon can be re-run for easy replication.
All algorithms are documented online; workflows are given in tutorials.

NWB Tool: Supported Data Formats

Personal Bibliographies
- Bibtex (.bib)
- Endnote Export Format (.enw)

Data Providers
- Web of Science by Thomson Scientific/Reuters (.isi)
- Scopus by Elsevier (.scopus)
- Google Scholar (access via *Publish or Perish* save as CSV, Bibtex, EndNote)
- Awards Search by National Science Foundation (.nsf)

Scholarly Database (all text files are saved as .csv)
- Medline publications by National Library of Medicine
- NIH funding awards by the National Institutes of Health (NIH)
- NSF funding awards by the National Science Foundation (NSF)
- U.S. patents by the United States Patent and Trademark Office (USPTO)
- Medline papers – NIH Funding

Network Formats
- NWB (.nwb)
- Pajek (.net)
- GraphML (.xml or .graphml)
- XGMML (.xml)

Burst Analysis Format
- Burst (.burst)

Other Formats
- CSV (.csv)
- Edgelist (.edge)
- Pajek (.mat)
- TreeML (.xml)

NWB Tool: Algorithms (July 1st, 2008)

See https://nwb.slis.indiana.edu/community and handout for details.

Preprocessing Edit

- **Remove Nodes**
  - Extract Top Nodes
  - Extract Nodes Above or Below Val
  - Delete High Degree Nodes
  - Delete Random Nodes
  - Delete Isolates
- **Remove Edges**
  - Extract Top Edges
  - Extract Edges Above or Below Val
  - Remove Self Loops
  - Trim By Degree[2]
  - Pathfinder Network Scaling
- **Sampling**
  - Snowball Sampling (n nodes)
  - Node Sampling
  - Edge Sampling
- **Transformations**
  - Symmetrize
  - Dichotomize
  - Multipartite Joining

Modeling Edit

- **General**
  - Random Graph
  - Watts-Strogatz Small World
  - Barabási-Albert Scale-Free
- **Structured**
  - CAN
  - Chord
- **Unstructured**
  - Hypergrid
  - PRU
- **Other**
  - TARL
  - Discrete Network Dynamics

Analysis Edit

- **General Purpose**
  - Network Analysis Toolkit[2]
- **Unweighted & Undirected**
  - **Based on degree/**
    - Node Degree
    - Node Distribution
  - **Based on clustering**
    - k-Nearest Neighbor
    - Watts Strogatz Clustering Coefficie
    - Watts Strogatz Clustering Coefficie
  - **Based on path**
    - Diameter
    - Average Shortest Path
    - Shortest Path Distribution
    - Node Betweenness Centrality
  - **Based on components**
    - Connected Components
    - Weak Component Clustering
  - **K-Core**
    - Extract K-Core[2]
    - Annotate K-Coreness[2]
- **Unweighted & Directed**
  - **Based on degree**
    - Node Indegree
    - Node Outdegree
    - Indegree Distribution
    - Outdegree Distribution
  - **Based on local graph structure**
    - k-Nearest Neighbor
    - Single Node In-Out Degree Correla
  - **Unnamed Category?**
    - Page Rank
  - **Based on local graph structure**
    - Dyad Reciprocity[2]
    - Arc Reciprocity[2]

Visualization Edit

- **Tools**
  - GUESS
  - GnuPlot[2]
- **Predefined Positions Layout**
  - DrL (VxOrd)
  - Pre-defined Positions (prefuse beta)[2]
- **Move**
  - Circular
- **Tree Layouts**
  - Radial Tree (prefuse alpha)
  - Radial Tree with Annotations (prefuse beta)[2]
  - Tree Map
  - Tree View
  - Balloon Graph (prefuse alpha)[2]
- **Network Layouts**
  - Force Directed with Annotation (prefuse beta)
  - Kamada-Kawai (JUNG)
  - Fruchterman-Reingold (JUNG)
  - Fruchterman-Reingold with Annotation (prefuse beta)
  - Spring (JUNG)
  - Small World (prefuse alpha)
- **Other Layouts**
  - Parallel Coordinates (demo)[2]
  - LaNet (k-Core Decomposition)

Scientometrics Edit

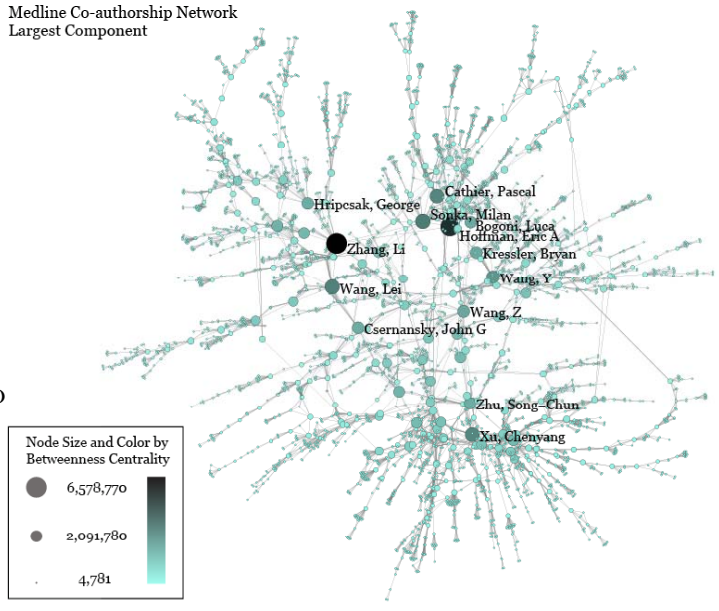
- **Extract Network From Table**
  - Extract Co-Authorship Network
  - Extract Co-Occurrence Network From Table[2]
  - Extract Directed Network From Table[2]
- **Extract Network From Another Network**
  - Extract Bibliographic Coupling Similarity Network
  - Extract Co-Citation Similarity Network[2]
- **Cleaning**
  - Remove ISI Duplicate Records

NWB Tool: Output Formats

- NWB tool can be used for data conversion. Supported output formats comprise:
- CSV (.csv)
- NWB (.nwb)
- Pajek (.net)
- Pajek (.mat)
- GraphML (.xml or .graphml)
- XGMML (.xml)

- GUESS
  Supports export of images into common image file formats.

- Horizontal Bar Graphs
  saves out raster and ps files.



Science of Science (Sci2) Tool

http://sci.slis.indiana.edu

- Explicitly designed for SoS research and practice, well documented, easy to use.
- Empowers many to run common studies while making it easy for exports to perform novel research.
- Advanced algorithms, effective visualizations, and many (standard) workflows.
- Supports micro-level documentation and replication of studies.
- Is open source—anybody can review and extend the code, or use it for commercial purposes.

nature

Vol 464|25 March 2010

OPINION

SUMMARY

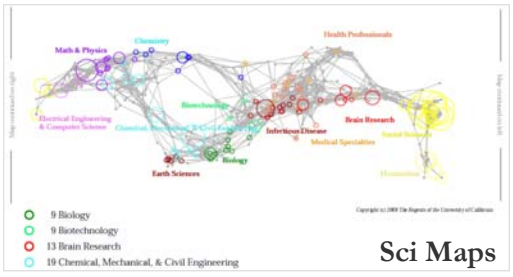
- Existing metrics have known flaws
- A reliable, open, joined-up data infrastructure is needed
- Data should be collected on the full range of scientists' work
- Social scientists and economists should be involved

Let's make science metrics more scientific

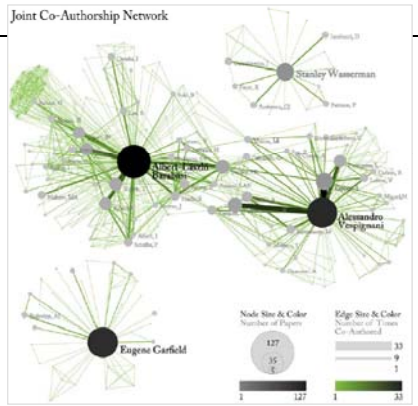
To capture the essence of good science, stakeholders must combine forces to create an open, sound and consistent system for measuring all the activities that make up academic productivity, says **Julia Lane**.

Sci² Tool – "Open Code for S&T Assessment"

OSGi/CIShell powered tool with NWB plugins and many new scientometrics and visualizations plugins.



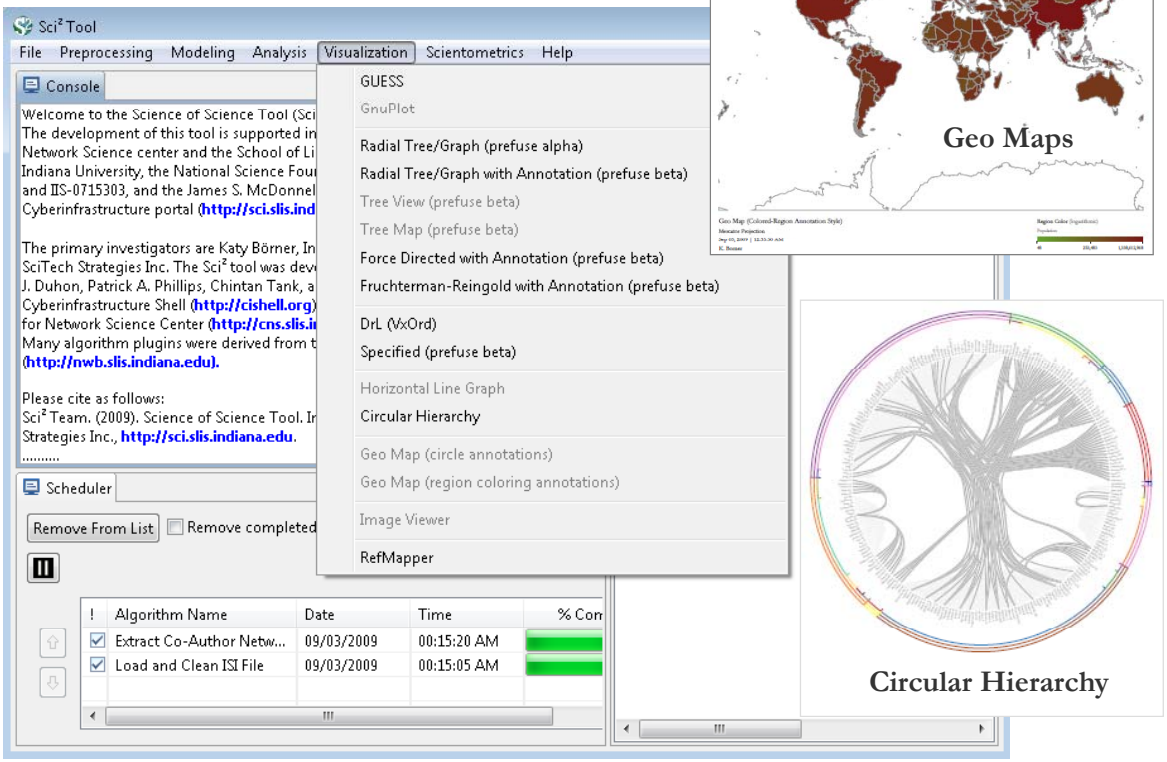
Sci Maps



GUESS Network Vis

Börner, Katy, Huang, Weixia (Bonnie), Linnemeier, Micah, Duhon, Russell Jackson, Phillips, Patrick, Ma, Nianli, Zoss, Angela, Guo, Hanning & Price, Mark. (2009). Rete-Netzwerk-Red: Analyzing and Visualizing Scholarly Networks Using the Scholarly Database and the Network Workbench Tool. Proceedings of ISSI 2009: 12th International Conference on Scientometrics and Informetrics, Rio de Janeiro, Brazil, July 14-17 . Vol. 2, pp. 619-630.

Sci² Tool



Sci² Tool: Algorithms

See https://nwb.slis.indiana.edu/community

Preprocessing
Extract Top N% Records
Extract Top N Records
Normalize Text
Slice Table by Line

Extract Top Nodes
Extract Nodes Above or Below Value
Delete Isolates

Extract top Edges
Extract Edges Above or Below Value
Remove Self Loops
Trim by Degree
MST-Pathfinder Network Scaling
Fast Pathfinder Network Scaling

Snowball Sampling (in nodes)
Node Sampling
Edge Sampling

Symmetrize
Dichotomize
Multipartite Joining

Geocoder

Extract ZIP Code

Modeling
Random Graph
Watts-Strogatz
Small World
Barabási-Albert Scale-Free
TARL

Analysis
Network Analysis Toolkit (NAT)
Unweighted & Undirected
- Node Degree
- Degree Distribution
- ---
- K-Nearest Neighbor (Java)
- Watts-Strogatz Clustering Coefficient
- Watts Strogatz Clustering Coefficient over K
- ---
- Diameter
- Average Shortest Path
- Shortest Path Distribution
- Node Betweenness Centrality
- ---
- Weak Component Clustering
- Global Connected Components
- ---
- Extract K-Core
- Annotate K-Coreness
- ---
- HITS

Weighted & Undirected
- Clustering Coefficient
- Nearest Neighbor Degree
- Strength vs Degree
- Degree & Strength
- Average Weight vs End-point Degree
- Strength Distribution
- Weight Distribution
- Randomize Weights
- ---
- Blondel Community Detection
- ---
- HITS

Unweighted & Directed
- Node Indegree
- Node Outdegree
- Indegree Distribution
- Outdegree Distribution
- ---
- K-Nearest Neighbor
- Single Node in-Out Degree Correlations
- ---
- Dyad Reciprocity
- Arc Reciprocity
- Adjacency Transitivity
- ---
- Weak Component Clustering
- Strong Component Clustering
- ---

Sci² Tool: Algorithms cont.

See https://nwb.slis.indiana.edu/community

Extract K-Core
Annotate K-Coreness

HITS
PageRank

Weighted & Directed
HITS
Weighted PageRank

Textual
Burst Detection

Visualization
GnuPlot
GUESS
Image Viewer

Radial Tree/Graph (prefuse alpha)
Radial Tree/Graph with Annotation (prefuse beta)
Tree View (prefuse beta)
Tree Map (prefuse beta)
Force Directed with Annotation (prefuse beta)
Fruchterman-Reingold with Annotation (prefuse beta)

DrL (VxOrd)
Specified (prefuse beta)

Horizontal Line Graph
Circular Hierarchy
Geo Map (Circle Annotation Style)
Geo Map (Colored-Region Annotation Style)
***Science Map (Circle Annotation)**

Scientometrics
Remove ISI Duplicate Records
Remove Rows with Multitudinous Fields
Detect Duplicate Nodes
Update Network by Merging Nodes

Extract Directed Network
Extract Paper Citation Network
Extract Author Paper Network

Extract Co-Occurrence Network
Extract Word Co-Occurrence Network
Extract Co-Author Network
Extract Reference Co-Occurrence (Bibliographic Coupling) Network
---
Extract Document Co-Citation Network

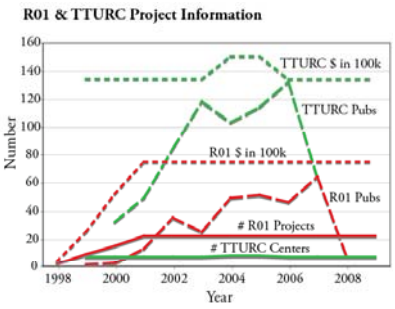
NEW:
Database support for ISI and NSF data.

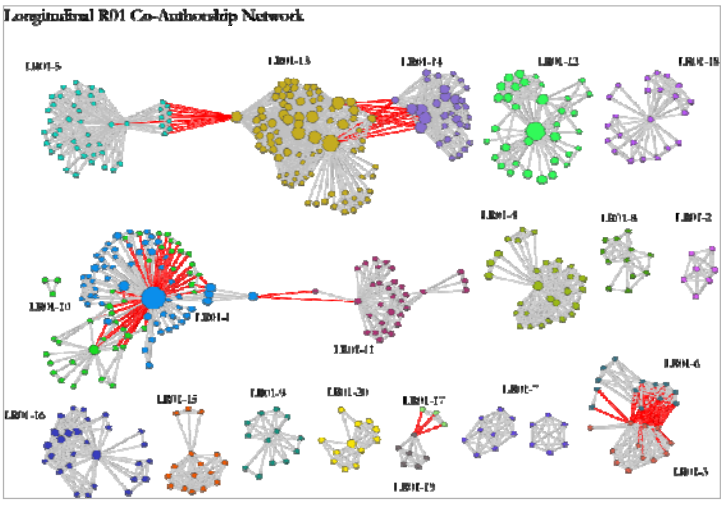
* Requires permission from UCSD
All four+ save into Postscript files.
Automatic legends.

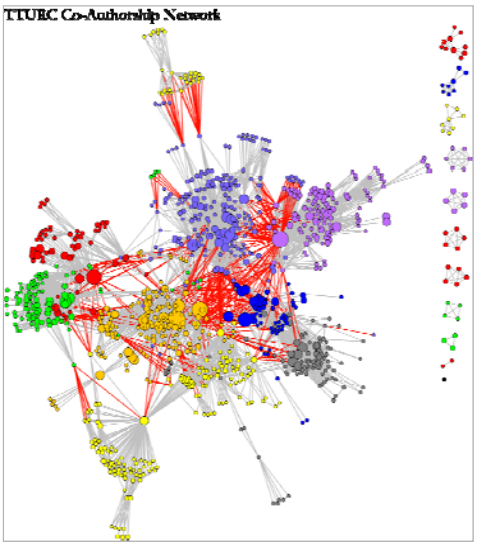
Mapping Transdisciplinary Tobacco Use Research Centers Publications

Compare R01 investigator based funding with TTURC Center awards in terms of number of publications and evolving co-author networks.

Zoss & Börner, forthcoming.

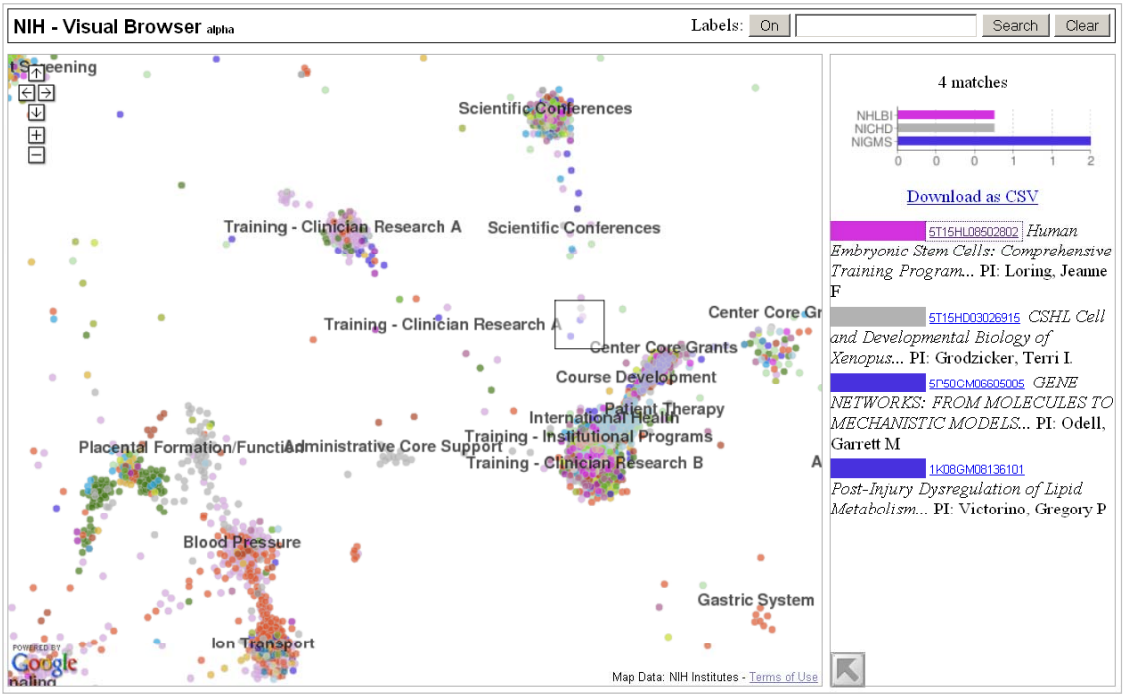






Interactive Science Map of NIH Funding

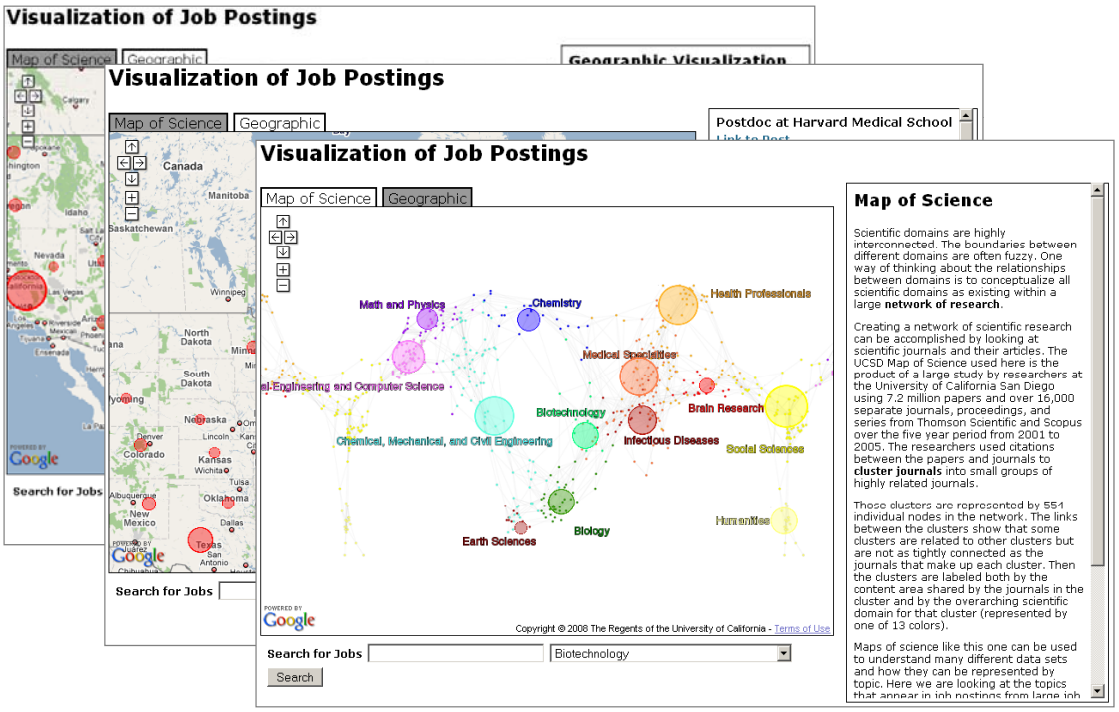
Herr II, Bruce W., Talley, Edmund M, Burns, Gully APC, Newman, David & La Rowe, Gavin. (2009).



http://scimaps.org/maps/nih/2007

Where Are the Academic Jobs? Interactive Exploration of Job Advertisements in Geospatial and Topical Space

Angela Zoss, Michael Connover, Katy Börner (2010)



http://cns-nd3.slis.indiana.edu/mapjobs/geo

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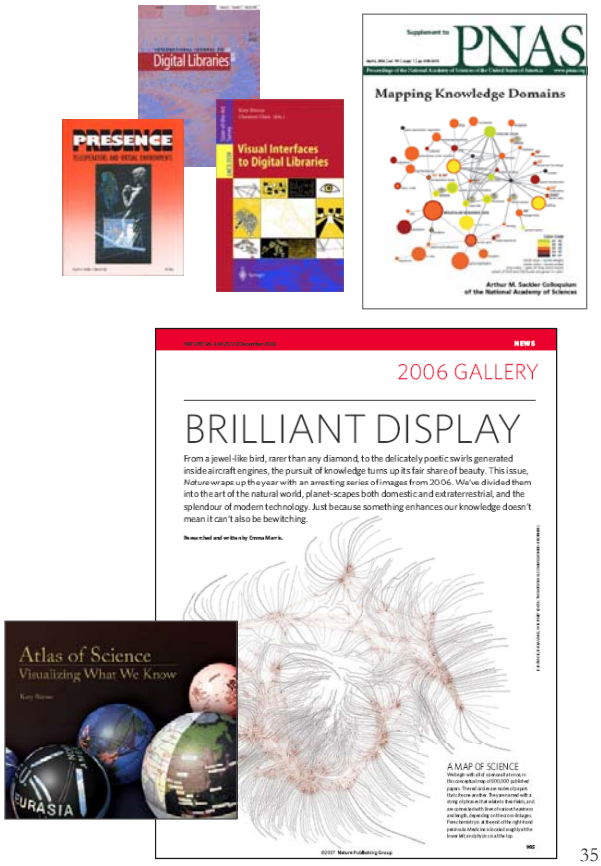
Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003). **Visualizing Knowledge Domains.** In Blaise Cronin (Ed.), *ARIST*, Medford, NJ: Information Today, Inc./American Society for Information Science and Technology, Volume 37, Chapter 5, pp. 179-255. http://ivl.slis.indiana.edu/km/pub/2003-borner-arist.pdf

Shiffrin, Richard M. and Börner, Katy (Eds.) (2004). **Mapping Knowledge Domains**. *Proceedings of the National Academy of Sciences of the United States of America*, 101(Suppl_1). http://www.pnas.org/content/vol101/suppl_1/

Börner, Katy, Sanyal, Soma and Vespignani, Alessandro (2007). **Network Science.** In Blaise Cronin (Ed.), *ARIST*, Information Today, Inc./American Society for Information Science and Technology, Medford, NJ, Volume 41, Chapter 12, pp. 537-607. http://ivl.slis.indiana.edu/km/pub/2007-borner-arist.pdf

Börner, Katy (2010) Atlas of Science. MIT Press. http://scimaps.org/atlas



Discussion and Outlook

A number of other projects recently adopted OSGi and one adopted CIShell:

Cytoscape (http://www.cytoscape.org) lead by Trey Ideker, UCSD is an open source bioinformatics software platform for visualizing molecular interaction networks and integrating these interactions with gene expression profiles and other state data (Shannon et al., 2002).

Taverna Workbench (http://taverna.sourceforge.net) lead by Carol Goble, University of Manchester, UK is a free software tool for designing and executing workflows (Hull et al., 2006). Taverna allows users to integrate many different software tools, including over 30,000 web services.

MAEviz (https://wiki.ncsa.uiuc.edu/display/MAE/Home) managed by Shawn Hampton, NCSA is an open-source, extensible software platform which supports seismic risk assessment based on the Mid-America Earthquake (MAE) Center research.

TEXTrend (http://www.textrend.org) lead by George Kampis, Eötvös University, Hungary develops a framework for the easy and flexible integration, configuration, and extension of plugin-based components in support of natural language processing (NLP), classification/mining, and graph algorithms for the analysis of business and governmental text corpuses with an inherently temporal component.

As the functionality of OSGi-based software frameworks improves and the number and diversity of dataset and algorithm plugins increases, the capabilities of custom tools will expand.

Discussion & Outlook cont.

Star Scientist -> Research Teams might have 100 or more members & exist few months only.
Users -> Contributors students, faculty, practitioners.
Disciplinary -> Cross-disciplinary with different cultures, languages, approaches.
One Specimen -> Data Streams updated nightly or even more frequently

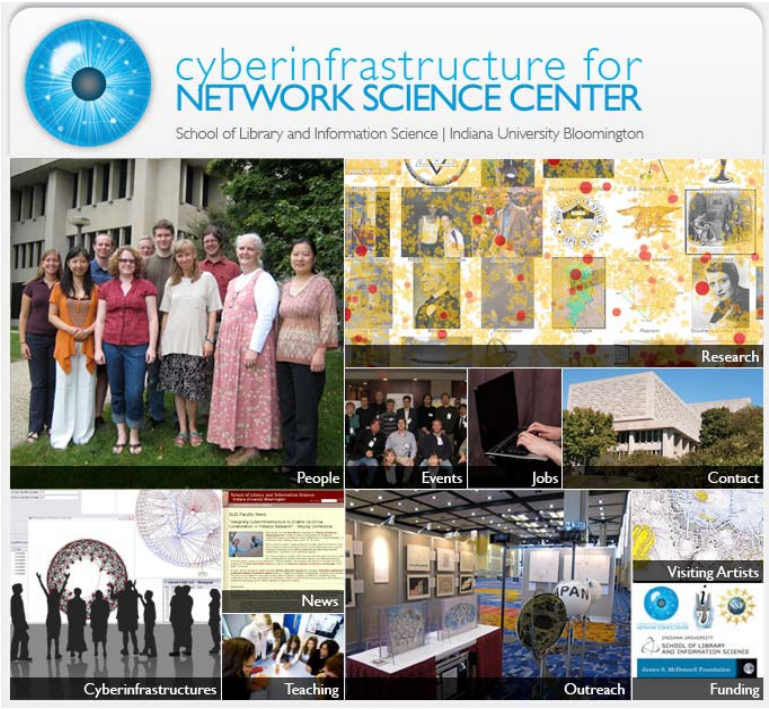
High Quality Open Data

Scholarly Database: 23 million scholarly records
http://sdb.slis.indiana.edu

VIVO National Researcher Networking
http://vivoweb.org

Static Instrument -> Evolving Cyberinfrastructure (CI) daily learning and documentation.

Macroscopes can make a major difference if they support:
Division of Labor – proper incentive structures are key.
Ease of Use – learn from YouTube, Flickr, Wikipedia
Modularity – plug-and-play helps reduce costs; increases flexibility, augmentation, customization
Standardization – speeds up 'translation' into products/practice.
Open Data and Open Code – use the minds of millions!



All papers, maps, cyberinfrastructures, talks, press are linked from http://cns.slis.indiana.edu