

Envisioning Science and Technology

Katy Börner

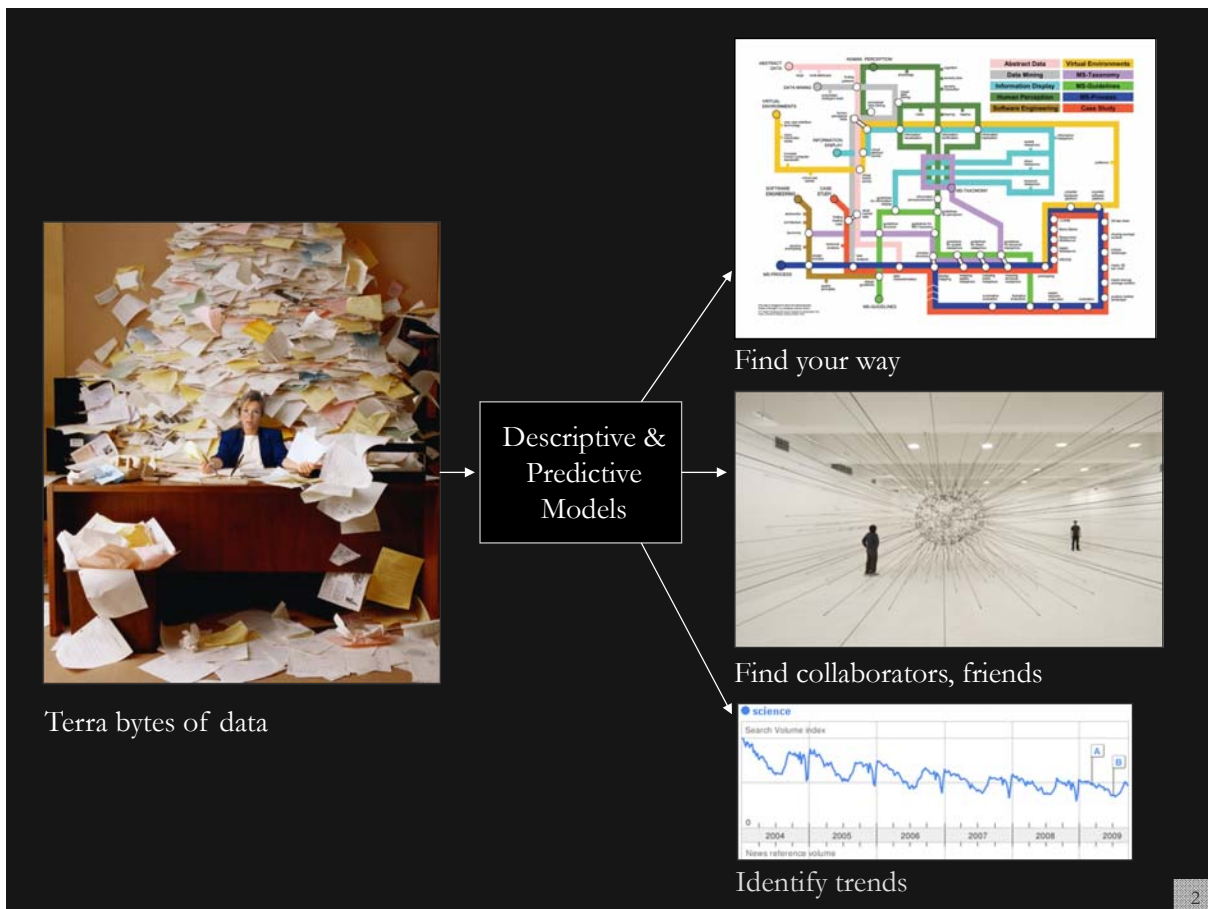
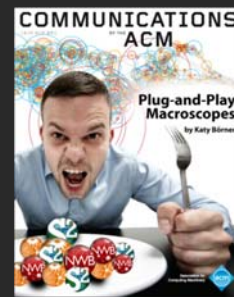
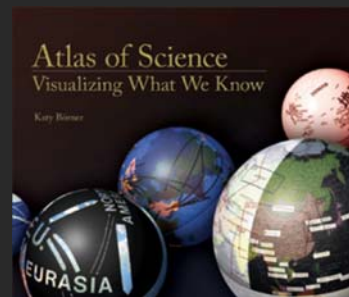
Cyberinfrastructure for Network Science Center, Director
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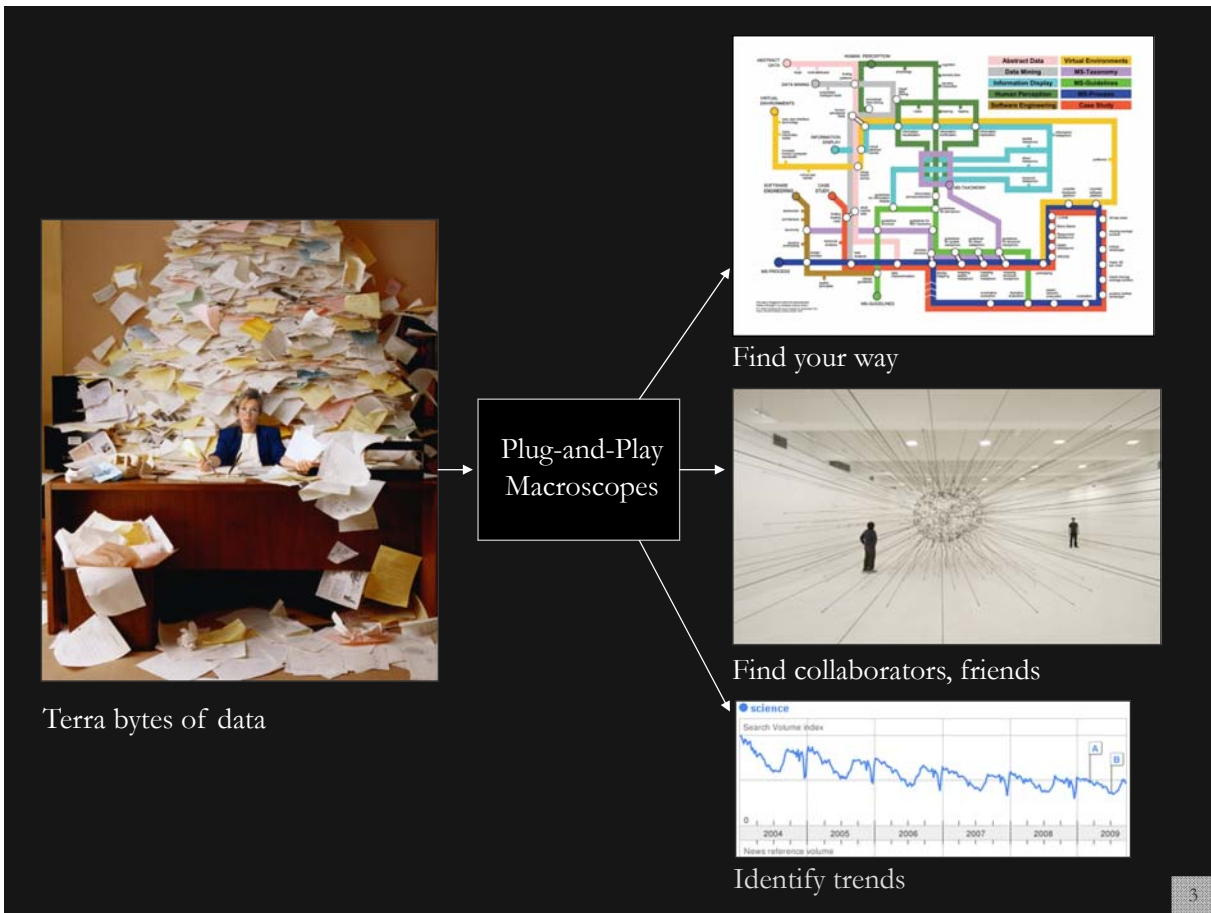


With special thanks to the members at the Cyberinfrastructure for Network Science Center and the Sci2 Tool team

*4th Biennial ISPST Conference
Pittsburgh, PA*

July 21, 2012`





Type of Analysis vs. Level of Analysis

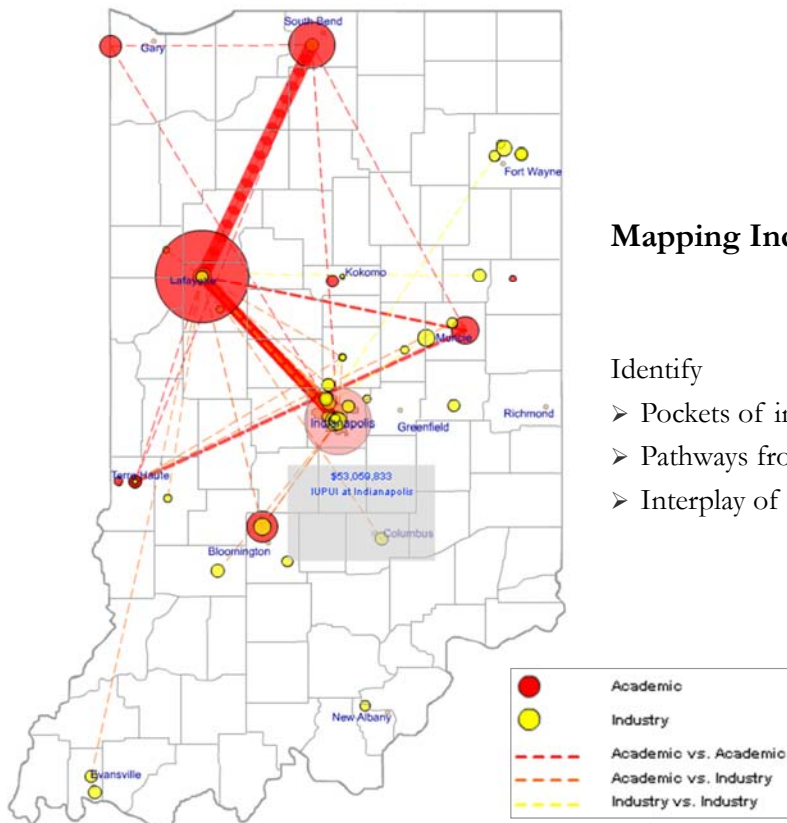
	<i>Micro/Individual</i> (1-100 records)	<i>Meso/Local</i> (101-10,000 records)	<i>Macro/Global</i> (10,000 < records)
Statistical Analysis/Profiling	Individual person and their expertise profiles	Larger labs, centers, universities, research domains, or states	All of NSF, all of USA, all of science.
Temporal Analysis (When)	Funding portfolio of one individual	Mapping topic bursts in 20-years of PNAS	113 Years of Physics Research
Geospatial Analysis (Where)	Career trajectory of one individual	Mapping a states intellectual landscape	PNAS publications
Topical Analysis (What)	Base knowledge from which one grant draws.	Knowledge flows in Chemistry research	VxOrd/Topic maps of NIH funding
Network Analysis (With Whom?)	NSF Co-PI network of one individual	Co-author network	NIH's core competency

Type of Analysis vs. Level of Analysis

	Micro/Individual (1-100 records)	Meso/Local (101-10,000 records)	Macro/Global (10,000 < records)
Statistical Analysis/Profiling	Individual person and their expertise profiles	Larger labs, centers, universities, research domains, or states	All of NSI, SA, all of sci
Temporal Analysis (When)	Funding portfolio of one individual	Public bursts of PNAS	113 Years of P Research
Geospatial Analysis (Where)	Career trajectory of one individual	Wrapping a s intellectual l	PNAS
Topical Analysis (What)		research	VxOrd/Topic r NIH funding
Network Analysis (With Whom?)	NSI work of one	work	NIH's cy



5



Mapping Indiana's Intellectual Space

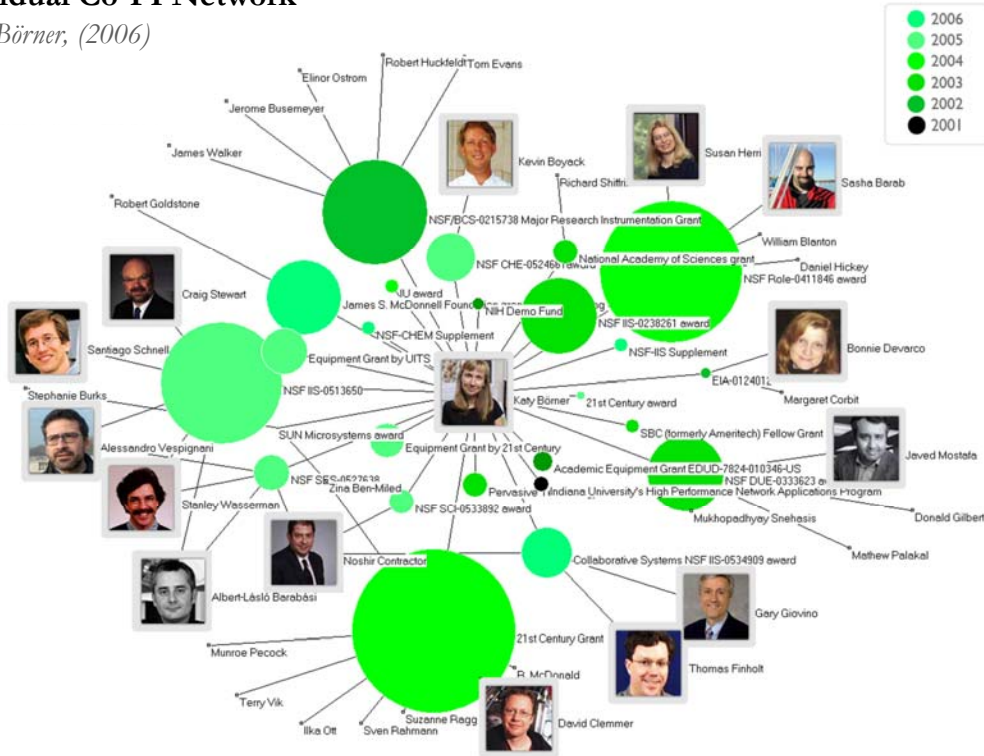
Identify

- Pockets of innovation
- Pathways from ideas to products
- Interplay of industry and academia

6

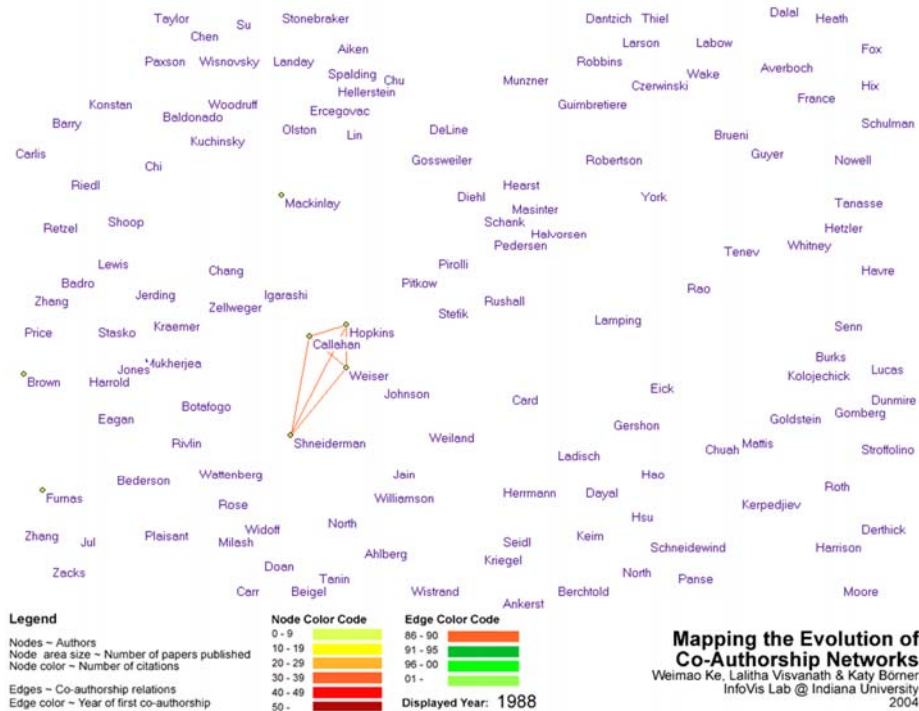
Individual Co-PI Network

Ke & Börner, (2006)



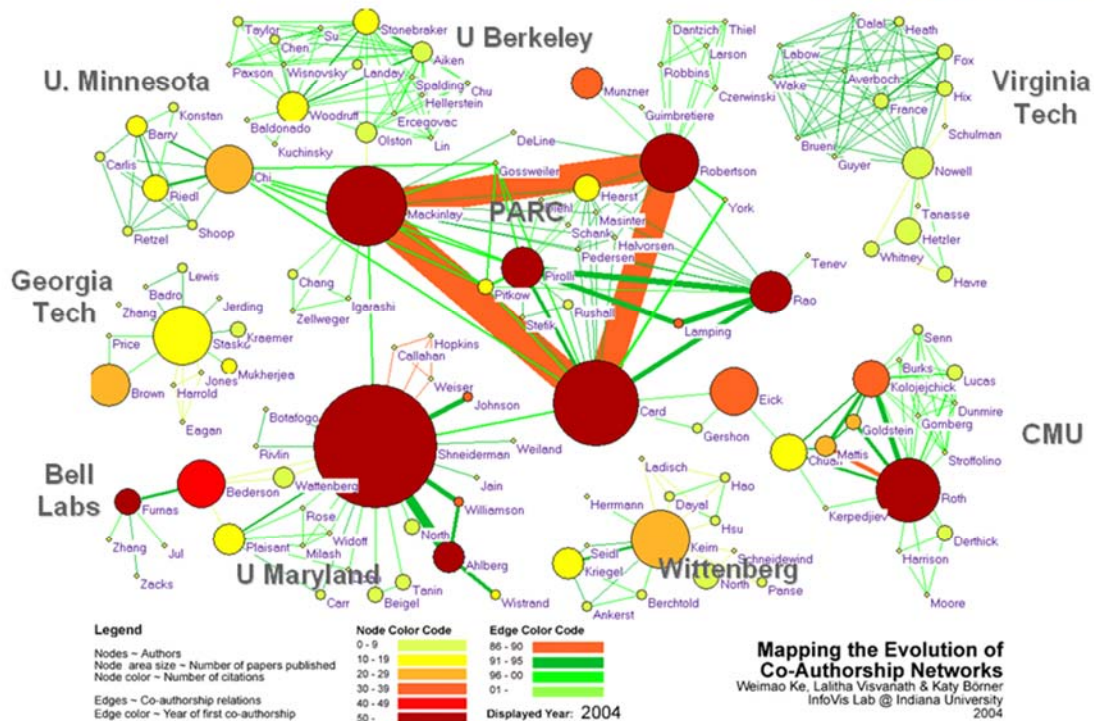
Mapping the Evolution of Co-Authorship Networks

Ke, Visvanath & Börner, (2004) Won 1st price at the IEEE InfoVis Contest.



Mapping the Evolution of Co-Authorship Networks

Ke, Viswanath & Börner, (2004) Won 1st price at the IEEE InfoVis Contest



9

Studying the Emerging Global Brain: Analyzing and Visualizing the Impact of Co-Authorship Teams

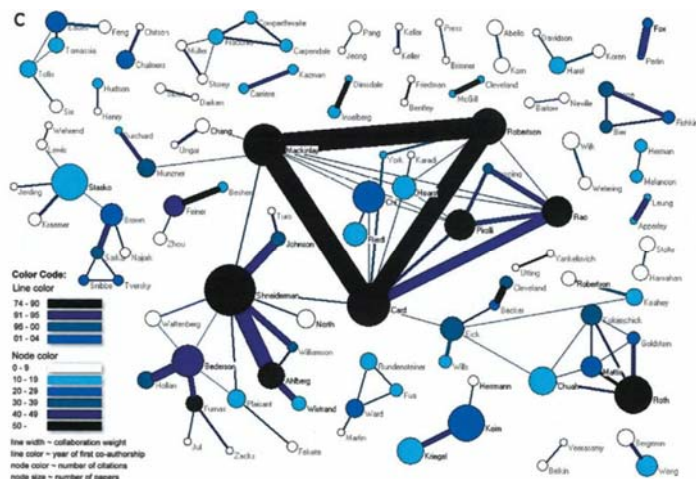
Börner, Dall'Asta, Ke & Vespignani (2005)
Complexity, 10(4):58-67.

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.



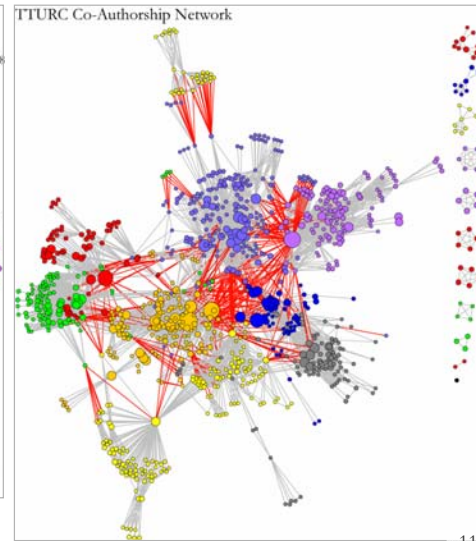
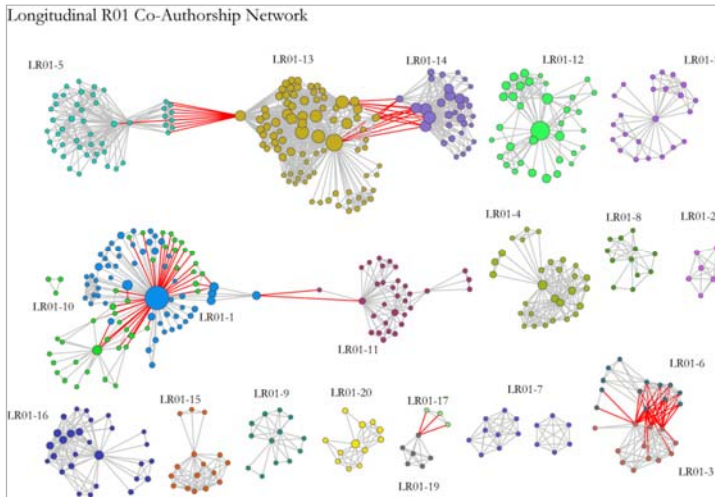
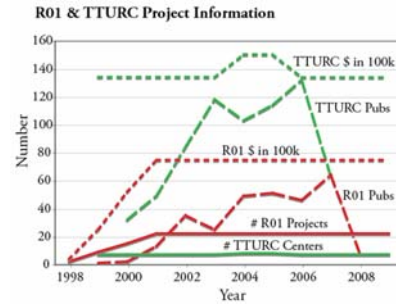
10

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*.

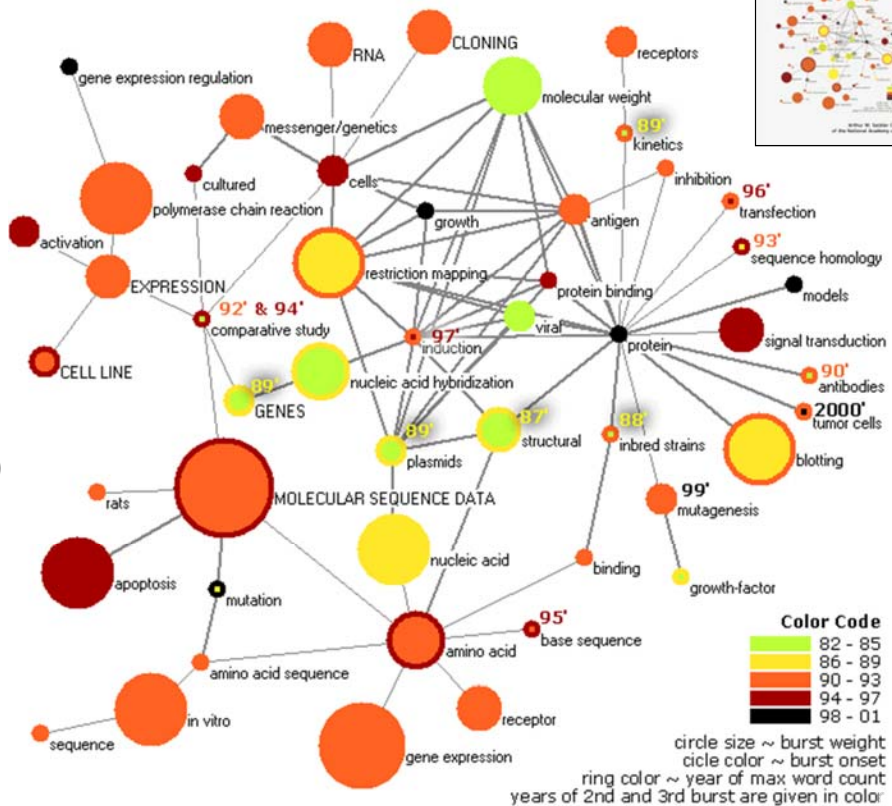
Supported by NIH/NCI Contract HHSN261200800812



Mapping Topic Bursts

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

Mane & Börner. (2004) PNAS, 101(Suppl. 1): 5287-5290.



Spatio-Temporal Information Production and Consumption of Major U.S. Research Institutions

Börner, Katy, Penumarty, Shashikant, Meiss, Mark and Ke, Weimao. (2006)
Mapping the Diffusion of Scholarly Knowledge Among Major U.S. Research Institutions. Scientometrics. 68(3), pp. 415-426.



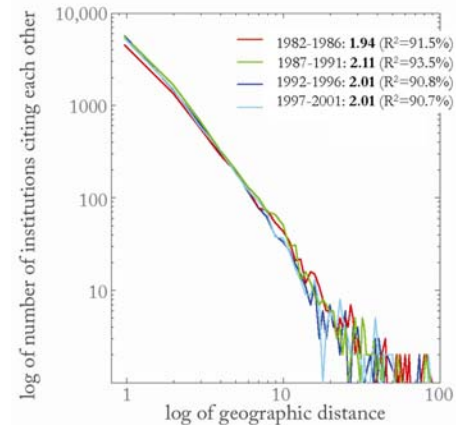
Research questions:

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 expertise and to produce 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:

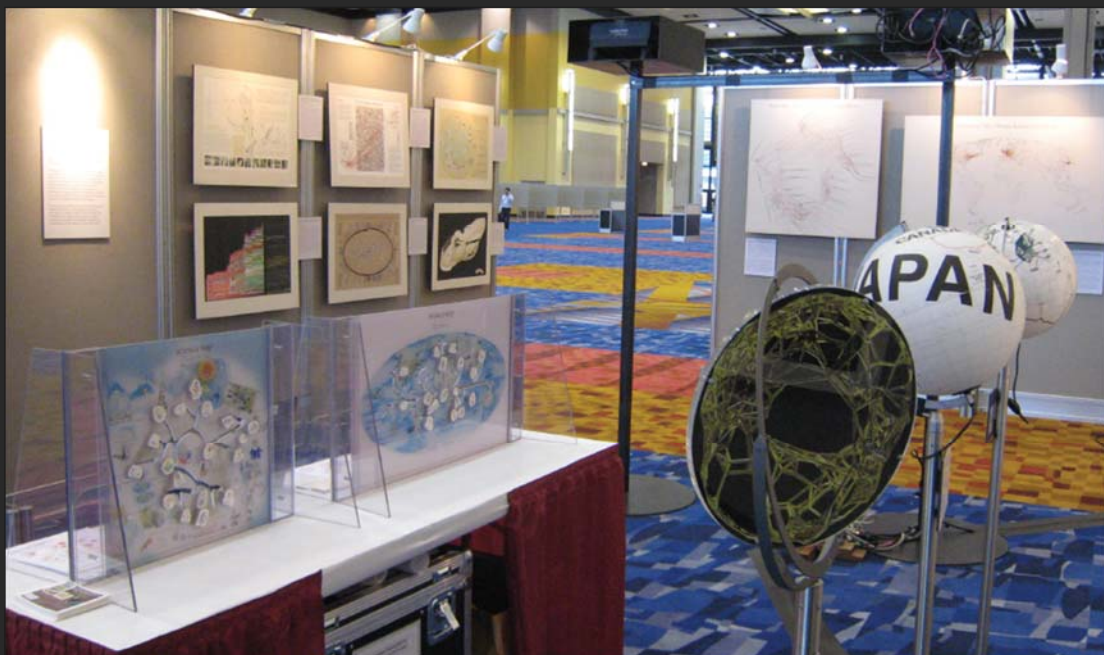
- Answer to Qs 1 + 2 is YES.
- Answer to Qs 3 is NO.
- Novel approach to analyzing the dual role of institutions as information producers and consumers and to study and visualize the diffusion of information among them.



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Mapping Science Exhibit – 10 Iterations in 10 years

<http://scimaps.org/>

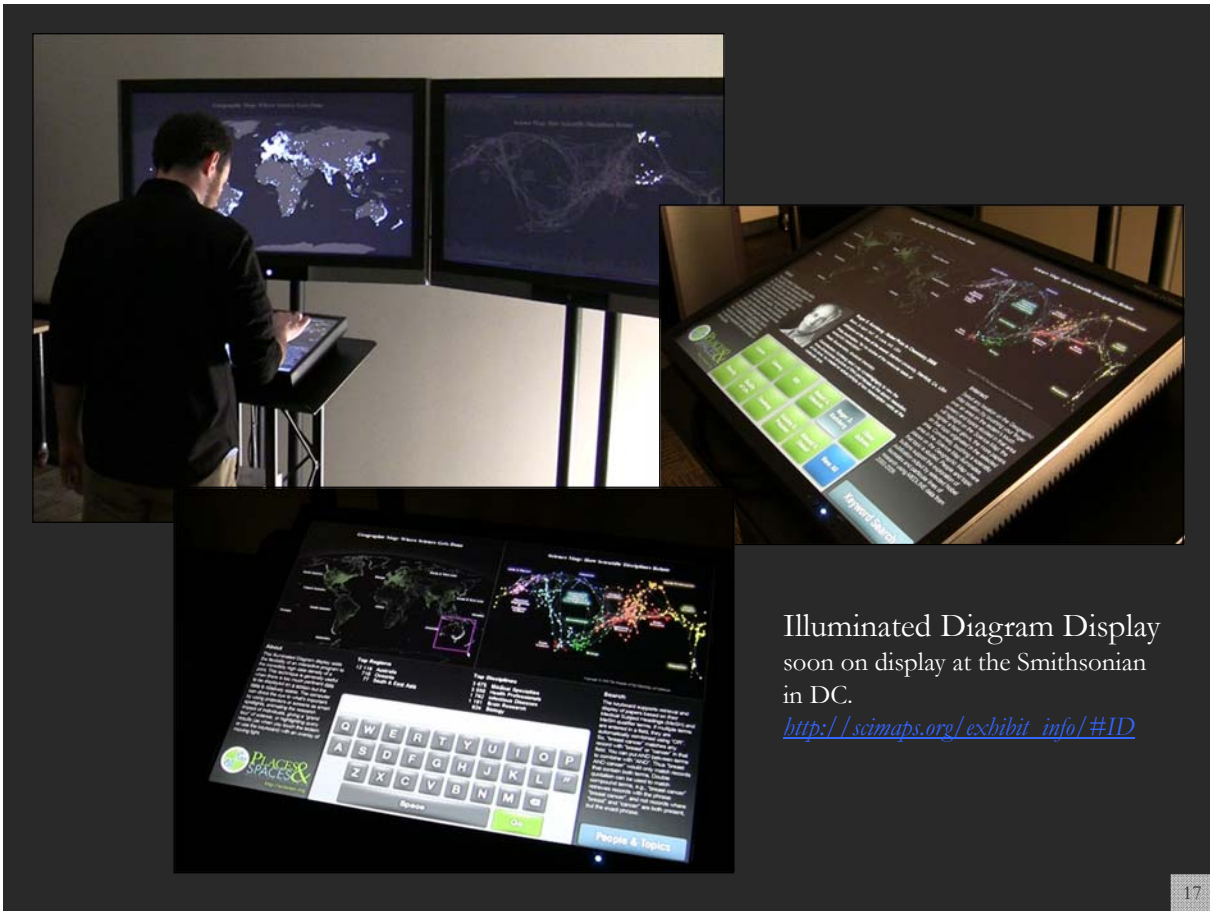




Mapping Science Exhibit at MEDIA X was on May 18, 2009 at Wallenberg Hall, Stanford University,
<http://mediax.stanford.edu>, <http://scaleindependentthought.typepad.com/photos/scimaps>



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>



Illuminated Diagram Display soon on display at the Smithsonian in DC.
http://scimaps.org/exhibit_info/#ID

Geographic Map: Where Science Gets Done

Science Map: How Scientific Disciplines Relate

Copyright © 2008 The Regents of the University of California

About

This Illuminated Diagram display adds the flexibility of an interactive program to the incredibly high data density of a print. This technique is generally useful when there is too much pertinent data to be displayed on a screen but the data is relatively stable. The computer can direct the eye to what's important by using projectors or screens as smart spotlights, animating the research impact of individuals, giving a "grand tour" of science, or highlighting query results (as when you touch the lectern or use the keyboard) with an overlay of moving light.

Elinor Ostrom - Nobel Prize in Economic Sciences 2009

Born: 7 August 1933, New York, NY, USA

Affiliation at the time of the award: Indiana University, Bloomington, IN, USA, Arizona State University, Tempe, AZ, USA

Prize motivation: "for her analysis of economic governance, especially the commons"

Field: Economic governance

Contribution: Challenged the conventional wisdom by demonstrating how local property can be successfully managed by local commons without any regulation by central authorities or privatization.

Interact

Select any location on the Geographic Map location (by brushing your finger over an area on the lectern's touch screen) and topics studied in that area will highlight on the Science Map; the brighter a topic glows, the more papers on that topic originated in the selected area. Conversely, touching a scientific area in the Science Map illuminates places on the Geographic Map where that topic is studied. People and topic buttons support the exploration of publication output by selected Noble laureates and particular lines of research using MEDLINE data from 2000-2009.

Cancer

Cloning

HIV

Robert G. Edwards

Roger D. Kornberg

Elinor Ostrom

Obesity

Quality of Life

Smoking

Stanley B. Prusiner

Ahmed H. Zewail

View All

Keyword Search

Geographic Map: Where Science Gets Done

North America, Central America, South America, Oceania, Europe, Africa, Asia, North & West Asia, South & East Asia, Oceania, America

Science Map: How Scientific Disciplines Relate

Math & Physics, Chemistry, Health Professionals, Social Sciences, Humanities, Medicine, Medical Specialties, Research, Molecular Diseases, Biology, Earth Sciences, Electrical Engineering & Computer Science, Advancement of Chemical, Mechanical, & Civil Engineering, Biotechnology

Copyright © 2008 The Regents of the University of California

About

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Top Five Continents

- North America - 4,000 records
- South & East Asia - 3,589
- Australia - 2,431
- Africa - 2,208
- South America - 1,562

Top Five Scientific Disciplines

- Math & Physics - 4,000 records
- Health Professionals - 3,589
- Social Sciences - 2,431
- Aeronautical, Chemical, Mechanical & Civil Engineering - 2,208
- Humanities - 1,562

Search

The keyboard supports retrieval and display of papers based on their Medical Subject Headings (MeSH) and MeSH qualifier terms. If multiple terms are entered in a field, they are automatically combined using "OR". So, "breast cancer" matches any record with "breast" or "cancer" in that field. You can put AND between terms to combine with "AND". Thus "breast AND cancer" would only match records that contain both terms. Double quotation can be used to match compound terms, e.g., "breast cancer" retrieves records with the phrase "breast cancer", and not records where "breast" and "cancer" are both present, but the exact phrase.

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Space

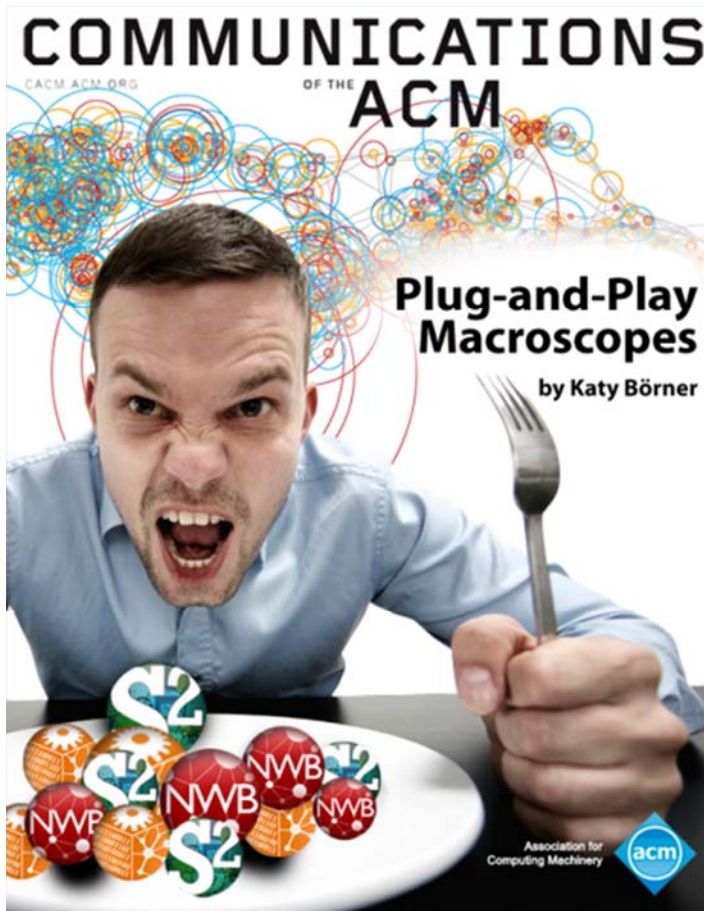
Go

People & Topics

19

PLACES & SPACES
SCIENCE MAPS
<http://scimaps.org>





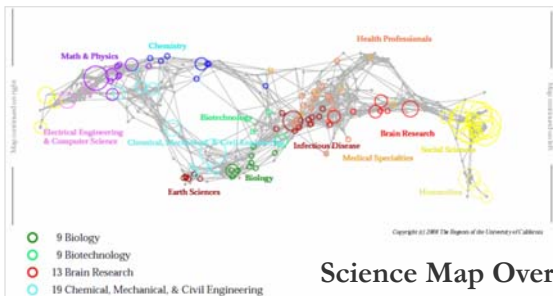
Börner, Katy. (March 2011). Plug-and-Play Macroscopes. *Communications of the ACM*, 54(3), 60-69.

Video and paper are at <http://www.scivee.tv/node/27704>

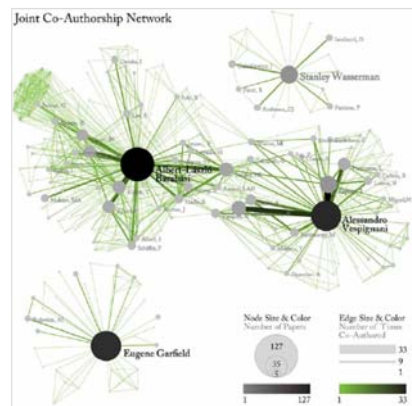


Science of Science (Sci²) Tool – Open Code for S&T Assessment

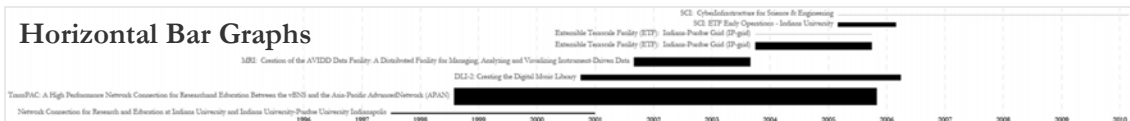
OSGi/CIShell powered tool with NWB plugins and many new scientometrics and visualizations plugins.



Science Map Overlays



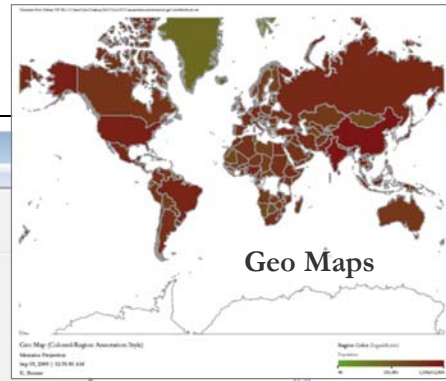
Network Visualizations



Börner, Katy. (2011). *Plug-and-Play Macroscopes*. *Communications of the ACM*, 54(3), 60-69. Video and paper are at <http://www.scivee.tv/node/27704>

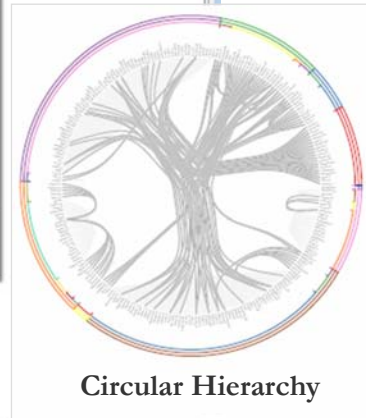


Sci² Tool cont.



The screenshot shows the Sci² Tool interface with the 'Visualization' menu open. The menu options include: GUESS, GnuPlot, 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 annotations), Geo Map (region coloring annotations), Image Viewer, and RefMapper.

!	Algorithm Name	Date	Time	% Con
<input checked="" type="checkbox"/>	Extract Co-Author Netw...	09/03/2009	00:15:20 AM	<div style="width: 100%;"></div>
<input checked="" type="checkbox"/>	Load and Clean ISI File	09/03/2009	00:15:05 AM	<div style="width: 100%;"></div>



Science of Science (Sci²) Tool – Usage

The Sci² Tool is used by the

- National Science Foundation,
- National Institutes of Health,
- US Department of Agriculture, and
- National Oceanic and Atmospheric Administration



Tool registrations come from 73 countries and professions such as



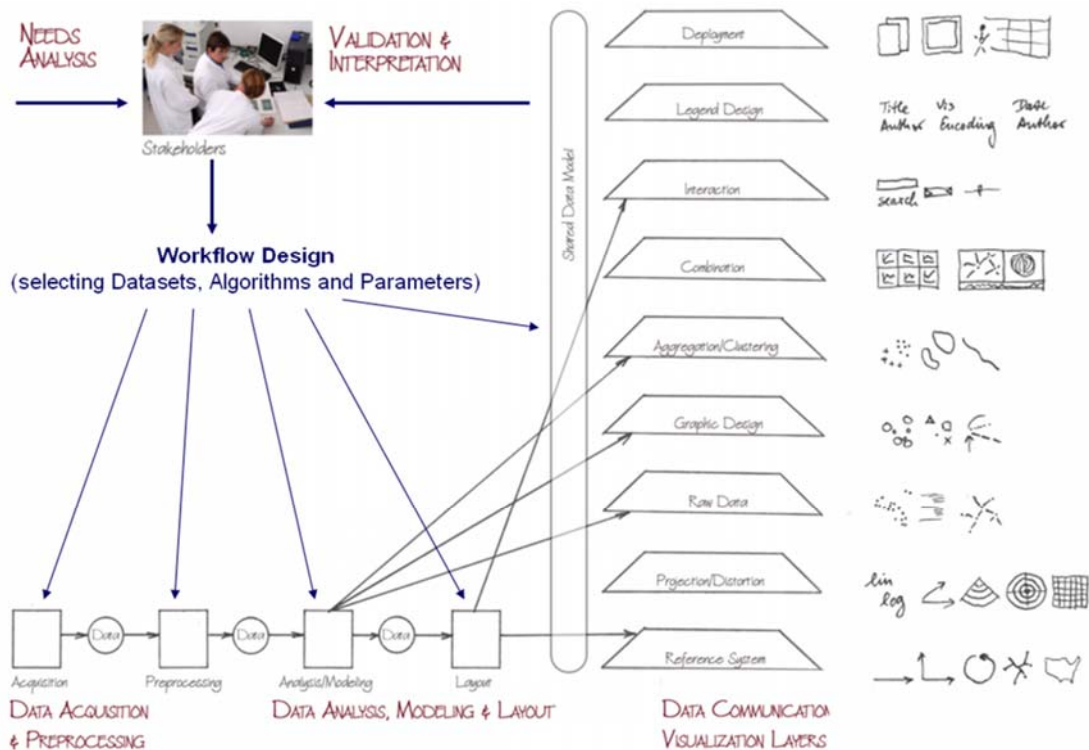


Sci² Tool – Type of Analysis vs. Level of Analysis

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Geospatial Analysis (Where)	Career trajectory of one individual	Mapping intellectual landscape	PNAS publications
Topical Analysis (What)	Knowledge flows in chemistry draws.	Knowledge flows in Chemistry research	VxOrd/Topic maps of NIH funding
Network Analysis (With Whom?)	NSF Co-PI network of individual	Co-author network	NIH co-author network

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Needs-Driven Workflow Design using a modular data acquisition/analysis/modeling/ visualization pipeline as well as modular visualization layers.

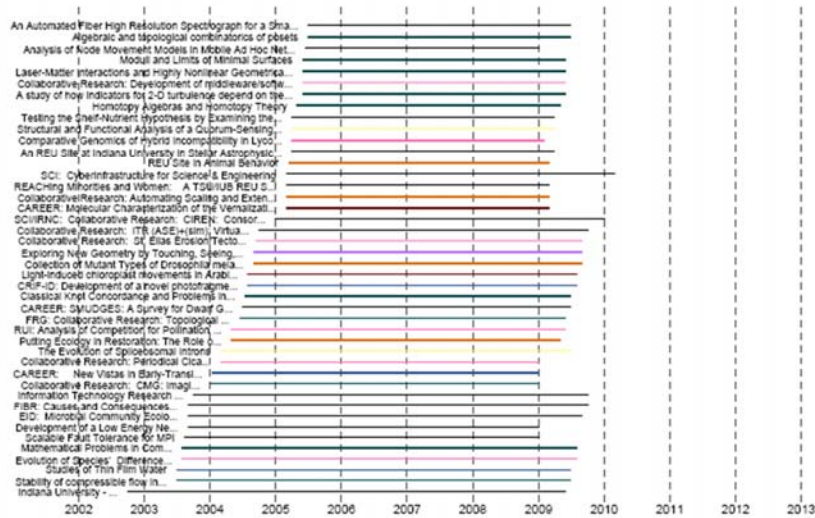




Temporal Visualizations

Temporal Visualization

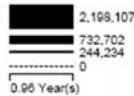
Generated from NSF csv file: C:\Users\katy\Desktop\TOOLS\Sci2-2012.06.04-KNAW\sampled\datascientometrics\indiana.csv
June 05, 2012 | 4:50 PM EDT



Legend

Area size: Award Number
Minimum = 220,560
Maximum = 952,043
Text label: Title
Color: NSF Organization
See end of PDF for color legend.

Area



How To Read This Map

This temporal bar graph visualization represents each record as a horizontal bar with a specific start and end date and a text label on its left side. The area of each bar encodes a numerical attribute value, e.g., total amount of funding. Bars may be colored to present categorical attribute values of records.

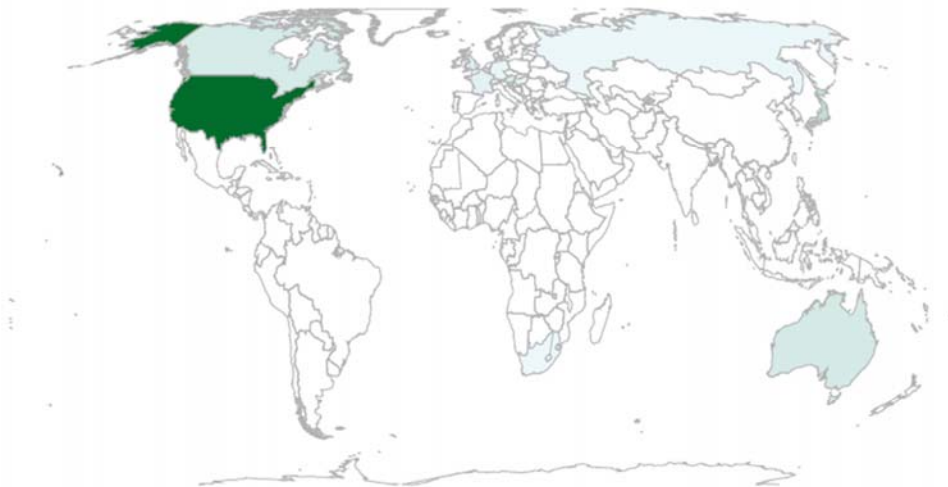
CNS (cns.iu.edu)



Geospatial Visualizations

Geospatial Visualization (Choropleth Map)

Generated from CSV file: Preprocessed-usptoInfluenza-8383730930137543104.csv
Jun 05, 2012 | 05:45:00 PM EDT



Legend



How to Read this Map

This choropleth map shows 206 countries of the world using the equal-area Eckert IV projection. Each country may be color coded in proportion to a numerical value. Minimum and maximum data values are given in the legend.

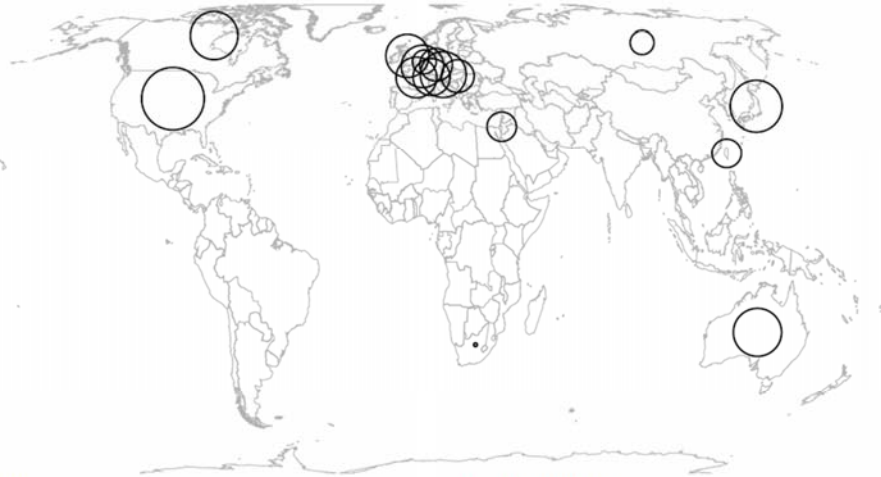
CNS (cns.iu.edu)



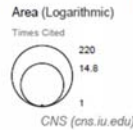
Geospatial Visualizations

Geospatial Visualization (Proportional Symbol Map)

Generated from CSV file: C:\sci2\samp\data\geolustol\influenza.csv
Jun 14, 2012 | 05:56:39 PM EDT

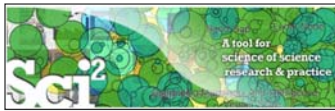


Legend



How to Read this Map

This proportional symbol map shows 209 countries of the world using the equal-area Eckert IV projection. Each dataset record is represented by a circle centered at its geolocation. The area, interior color, and exterior color of each circle may represent numeric attribute values. Minimum and maximum data values are given in the legend.



Topical Visualization

Topical Visualization

Generated from 361 Unique ISI Records of 4 NetSci Researchers
14 out of 109 publications were mapped to 94 subdisciplines and 12 disciplines.
June 05, 2012 | 05:39 PM EDT



Legend

Circle area: Fractional Journal Count
Unclassified = 95
Minimum = 0
Maximum = 25
Color: Discipline
See end of PDF for color legend.

Area



How to Read this Map

The UCSD map are aggregated by color and labeled with unique subdiscipline assigned records:

- Chemistry**
 - 1 CURRENT PHYSICS COMMUNICATIONS
 - 2 JOURNAL OF CHEMICAL INFORMATION AND COMPUTER SCIENCES
 - 3 JOURNAL OF THE ROYAL INSTITUTE OF SCIENCE
 - 4 PURE AND APPLIED CHEMISTRY
- Earth Sciences**
 - 1 CURRENT SCIENCE

Data: WoS and Scopus paper level data for 2001–2010, about 25,000 separate journals, proceedings, and series.

Similarity Metric: Combination of bibliographic coupling and keyword vectors.

Number of Disciplines: 554 journal clusters further aggregated into 13 main scientific disciplines that are labeled and color coded in a metaphorical way, e.g., Medicine is blood red and Earth Sciences are brown as soil.



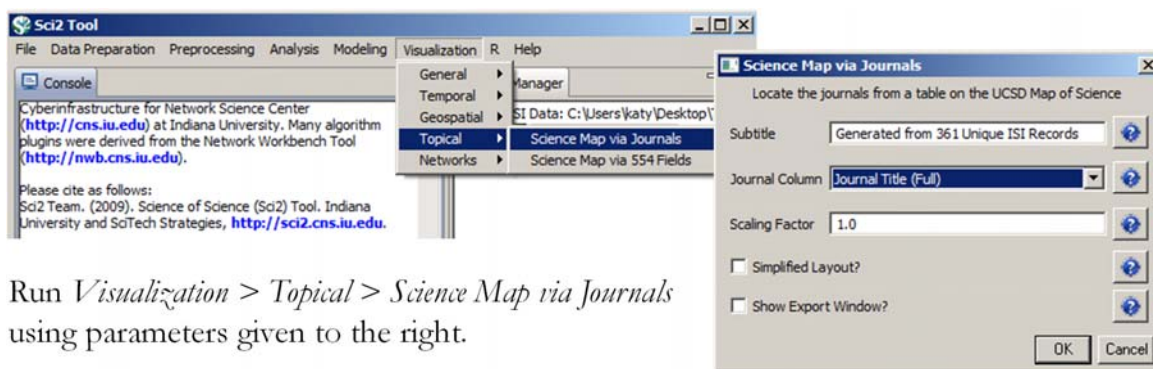
DIY Science Maps using the Sci2 Tool

Download Sci2 Tool v1.0 Alpha (June 13, 2012) from <http://sci2.cns.iu.edu>

Unpack into a /sci2 directory. Run /sci2/sci2.exe

Sci2 Manual is at <http://sci2.wiki.cns.iu.edu>

Load an ISI (*.isi), Bibtext (*.bib), Endnote Export Format (*.enw), Scopus csv (*.scopus) file such as /sci2/sampleddata/scientometrics/isi/FourNetSciResearchers.isi



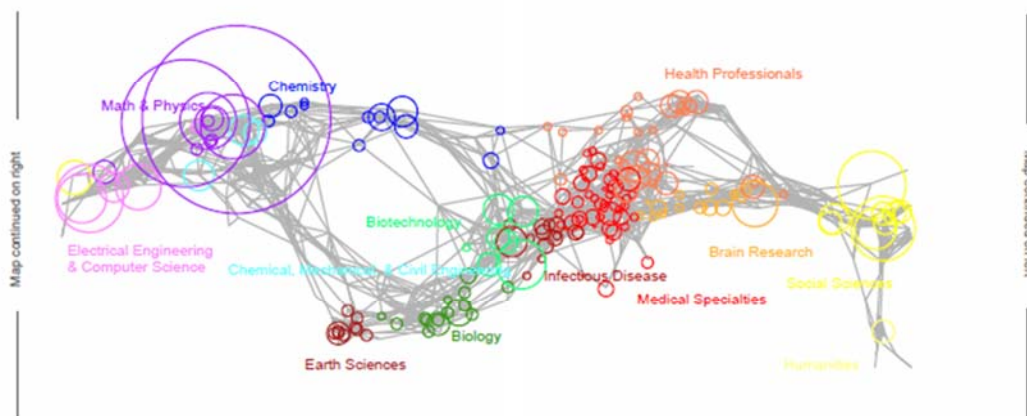
Run *Visualization > Topical > Science Map via Journals* using parameters given to the right.

Postscript file will appear in *Data Manager*. Save and open with a Postscript Viewer.

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Topical Visualization

Generated from 361 Unique ISI Records
90 out of 112 publications were mapped to 182 subdisciplines and 13 disciplines.
June 24, 2012 | 04:04 PM EDT

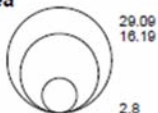


2008 The Regents of the University of California and SciTech Strategies.
Map updated by SciTech Strategies, OST, and CNS in 2011.

Legend

Circle area: Fractional Journal Count
Unclassified = 22
Minimum = 0
Maximum = 98
Color: Discipline
See end of PDF for color legend.

Area



How To Read This Map

The UCSD map of science depicts a network of 554 subdiscipline nodes that are aggregated to 13 main disciplines of science. Each discipline has a distinct color and is labeled. Overlaid are circles, each representing all records per unique subdiscipline. Circle area is proportional to the number of fractionally assigned records. Minimum and maximum data values are given in the legend.

CNS (cns.iu.edu)

Topical Visualization

Generated from 361 Unique ISI Records
90 out of 112 publications were mapped to 182 subdisciplines and 13 disciplines.
June 24, 2012 | 04:04 PM EDT

■ Biology

- 1 BMC EVOLUTIONARY BIOLOGY
- 1 NATURWISSENSCHAFTEN

■ Biotechnology

- 1 BMC BIOINFORMATICS
- 2 FEBS JOURNAL
- 1 GENOME RESEARCH
- 1 INTERNATIONAL MICROBIOLOGY
- 1 NATURE BIOTECHNOLOGY
- 3 NATURE GENETICS
- 1 NATURE REVIEWS GENETICS
- 1 NUCLEIC ACIDS RESEARCH
- 2 PROTEOMICS

■ Brain Research

- 5 JOURNAL OF MATHEMATICAL PSYCHOLOGY

■ Chemical, Mechanical, & Civil Engineering

- 1 JOURNAL OF CERAMIC PROCESSING RESEARCH
- 2 MATERIALS SCIENCE AND ENGINEERING A-STRUCTURAL MATERIA...
- 1 PHYSICS WORLD
- 1 SCIENTIFIC AMERICAN

■ Chemistry

- 1 COMPUTER PHYSICS COMMUNICATIONS
- 2 JOURNAL OF CHEMICAL INFORMATION AND COMPUTER SCIENCES
- 1 JOURNAL OF THE INDIAN INSTITUTE OF SCIENCE
- 1 PURE AND APPLIED CHEMISTRY

■ Earth Sciences

- 1 CURRENT SCIENCE

■ Electrical Engineering & Computer Science

- 1 ASIST 2003: PROCEEDINGS OF THE 66TH ASIST ANNUAL MEETING...
- 1 CANADIAN JOURNAL OF INFORMATION AND LIBRARY SCIENCE-REV...
- 5 IEEE TRANSACTIONS ON PROFESSIONAL COMMUNICATION
- 1 INFORMATION TECHNOLOGY AND LIBRARIES
- 5 JOURNAL OF INFORMATION SCIENCE
- 3 JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE
- 5 JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENC...
- 2 LIBRARY QUARTERLY
- 1 LIBRI
- 1 PROCEEDINGS OF THE AMERICAN SOCIETY FOR INFORMATION SC...

■ Health Professionals

- 1 ANNALS OF BIOMEDICAL ENGINEERING
- 1 BULLETIN OF THE MEDICAL LIBRARY ASSOCIATION
- 1 CROATIAN MEDICAL JOURNAL
- 2 JOURNAL OF APPLIED PHYSIOLOGY
- 1 JOURNAL OF PUBLIC HEALTH DENTISTRY
- 1 METHODS OF INFORMATION IN MEDICINE
- 1 PLASTIC AND RECONSTRUCTIVE SURGERY
- 1 TEXAS MEDICINE
- 1 UNFALLCHIRURG
- 1 WIENER KLINISCHE WOCHENSCHRIFT

■ Humanities

- 1 BULLETIN OF THE ATOMIC SCIENTISTS

■ Infectious Diseases

- 1 FEMS MICROBIOLOGY LETTERS
- 1 JOURNAL OF BACTERIOLOGY

■ Math & Physics

- 1 ADVANCES IN APPLIED PROBABILITY

CNS (cns.iu.edu)

Topical Visualization

Generated from 361 Unique ISI Records
90 out of 112 publications were mapped to 182 subdisciplines and 13 disciplines.
June 24, 2012 | 04:04 PM EDT

■ Math & Physics

- 10 APPLIED PHYSICS LETTERS
- 1 BRAZILIAN JOURNAL OF PHYSICS
- 3 CHAOS SOLITONS & FRACTALS
- 1 COMPLEXITY
- 1 COMPUTATIONAL MATERIALS SCIENCE
- 11 EUROPEAN PHYSICAL JOURNAL B
- 12 EUROPHYSICS LETTERS
- 2 INTERNATIONAL JOURNAL OF MODERN PHYSICS B
- 6 JOURNAL OF PHYSICS A-MATHEMATICAL AND GENERAL
- 1 JOURNAL OF STATISTICAL MECHANICS-THEORY AND EXPERIMENT
- 1 JOURNAL OF STATISTICAL PHYSICS
- 1 JOURNAL OF THE KOREAN PHYSICAL SOCIETY
- 1 MATERIALS SCIENCE AND ENGINEERING B-SOLID STATE MATERIAL...
- 3 NATURE PHYSICS
- 3 NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SEC...
- 12 PHYSICA A
- 5 PHYSICAL REVIEW A
- 2 PHYSICAL REVIEW B
- 45 PHYSICAL REVIEW LETTERS
- 2 REVIEWS OF MODERN PHYSICS

■ Medical Specialties

- 1 ANNALS OF INTERNAL MEDICINE
- 1 REVISTA DE INVESTIGACION CLINICA

■ Social Sciences

- 1 ADMINISTRATIVE SCIENCE QUARTERLY
- 1 AMERICAN BEHAVIORAL SCIENTIST
- 1 AMERICAN SOCIOLOGICAL REVIEW
- 1 ANNALS OF THE AMERICAN ACADEMY OF POLITICAL AND SOCIAL S...
- 1 ARBOR-CIENCIA PENSAMIENTO Y CULTURA
- 3 BRITISH JOURNAL OF MATHEMATICAL & STATISTICAL PSYCHOLOGY
- 1 JOURNAL OF CLASSIFICATION

■ Social Sciences

- 2 JOURNAL OF MATHEMATICAL SOCIOLOGY
- 3 JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION
- 2 PSYCHOLOGICAL BULLETIN
- 5 PSYCHOMETRIKA
- 1 RECHERCHE
- 5 SCIENTOMETRICS
- 1 SOCIAL FORCES
- 6 SOCIAL NETWORKS
- 3 SOCIOLOGICAL METHODS & RESEARCH

Multiple Categories

- 1 BRITISH MEDICAL JOURNAL
- 2 JAMA-JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION
- 1 JOURNAL OF THEORETICAL BIOLOGY
- 18 NATURE
- 44 PHYSICAL REVIEW E
- 5 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE ...
- 6 SCIENCE

Unclassified

- 1 ALGORITHMS AND MODELS FOR THE WEB-GRAPHS, PROCEEDINGS
- 2 AMERICAN DOCUMENTATION
- 2 ASIST 2002: PROCEEDINGS OF THE 65TH ASIST ANNUAL MEETING, ...
- 1 BIOLOGIYA MORYA-MARINE BIOLOGY
- 1 BULLETIN OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE
- 1 CHEMIKER-ZEITUNG
- 3 CHEMTECH
- 1 COMBINATORIAL AND ALGORITHMIC ASPECTS OF NETWORKING
- 7 CURRENT COMMENTS
- 3 CURRENT CONTENTS/LIFE SCIENCES
- 1 FEDERATION PROCEEDINGS
- 5 FRACTALS-AN INTERDISCIPLINARY JOURNAL ON THE COMPLEX GE...
- 1 FRONTIERS OF LIBRARIANSHIP-SYRACUSE UNIVERSITY

CNS (cns.iu.edu)



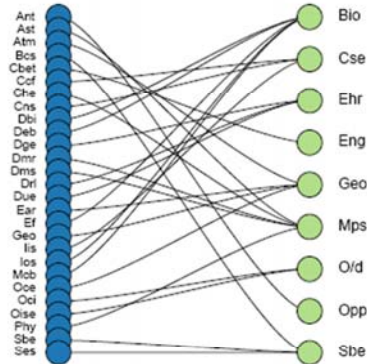
Network Visualizations

Network Visualization

Generated from bipartite network from NSF Organization to NSF Directorate
June 5, 2012 | 5:05 PM EDT

NSF Organization

NSF Directorate



Legend

Sorted by
Left side:
Alphabetical
Right side:
Alphabetical

How To Read This Map

This bipartite network shows two record types and their interconnections. Each record is represented by a labeled circle that is size coded by a numerical attribute value. Records of each type are vertically aligned and sorted, e.g., by node size or alphabetically. Links between records of different type may be weighted as represented by line thickness.

CNS (cns.iu.edu)

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Geomap with Gephi Network Overlay

See 4.7.6 on <http://sci2.wiki.cns.iu.edu>

File with geolocations and linkage info, e.g., an isi bibliography file.



Use Yahoo! Geocoder to identify Latitude, Longitude for each geolocation
Extract attributes per geolocation, e.g., total times cited (TC)
Extract linkages and their attributes, e.g., number of co-occurrences
See sample /geo/LaszloBarabasiGeo.net with co-occurrence of “Research Addresses” and full counting of TC per geolocation.



Read into Sci2 Tool to generate geomap and network file



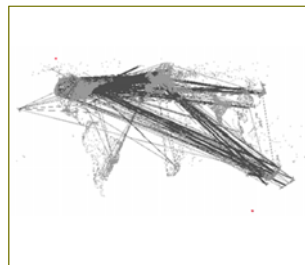
Layout network in Gephi



Combine geomap and network in Photoshop



+

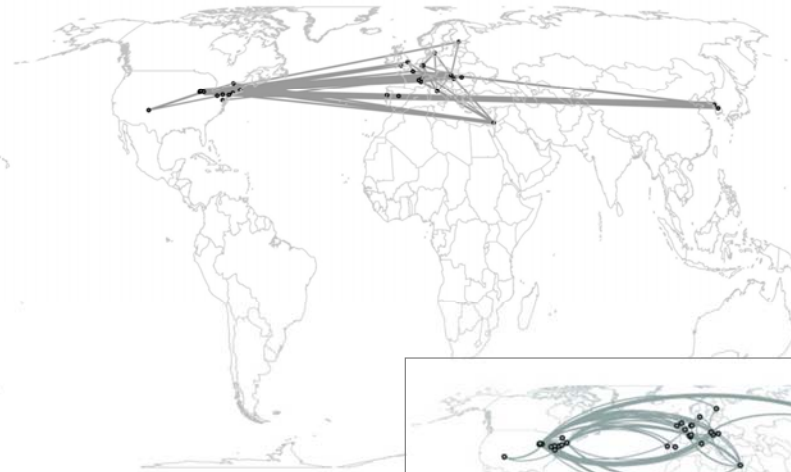


=



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Practice these steps using “LaszloBarabasi-collaborations.net” linked from Sci2 wiki:
4.7.6 Using Gephi to Render Networks Overlaid on GeoMaps



Geo Map ()
 Eckert IV Projection
 Apr 11, 2012 | 06:20:13 AM

Created with Sci² Tool | CytoInfrastructure for Network Science Center (<http://amsi.ac.uk>)



Rounded edges might increase legibility of overlapping lines.

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Code & Documentation



Forgot your password? Katy Börner (2010) Science of Science Research and Tools (12 Tutorials). Reporting Branch, Office of Extramural Research/Office of the Director, National Institutes of Health, Bethesda, MD.

To recover your password, please contact the Sci2 Tool support team.

Not registered?

Register now!

Tutorials

Scott Weingaertner
 Biberstine (2010)
 Science, Indiana

- Tutorial #01: [Science of Science Research](#)
- Tutorial #02: [Network Science / Information Visualization](#)
- Tutorial #03: [CIShell Powered Tools: Network Workbench and Science of Science Tool](#)
- Tutorial #04: [Temporal Analysis—Burst Detection](#)
- Tutorial #05: [Geospatial Analysis and Mapping](#)
- Tutorial #06: [Topical Analysis & Mapping](#)
- Tutorial #07: [Tree Analysis and Visualization](#)
- Tutorial #08: [Network Analysis and Visualization](#)
- Tutorial #09: [Large Network Analysis and Visualization](#)
- Tutorial #10: [Using the Scholarly Database at IU](#)
- Tutorial #11: [VIVO National Researcher Networking](#)
- Tutorial #12: [Future Developments](#)

<http://sci2.cns.iu.edu>

<http://sci2.wiki.cns.iu.edu>

Geetha Senthil (2010) [Multidisciplinary Nature of Work With Reference to PIs and ICs Within a Portfolio](#). PA Group at NIH.

NIH Office of Extramural Research and Katy Börner (2010) [Network Visualizations Using SPIRES Data and the Sci2 Tool](#). Office of Extramural Research at NIH.

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Supports federated search of 25 million publication, patent, grant records.

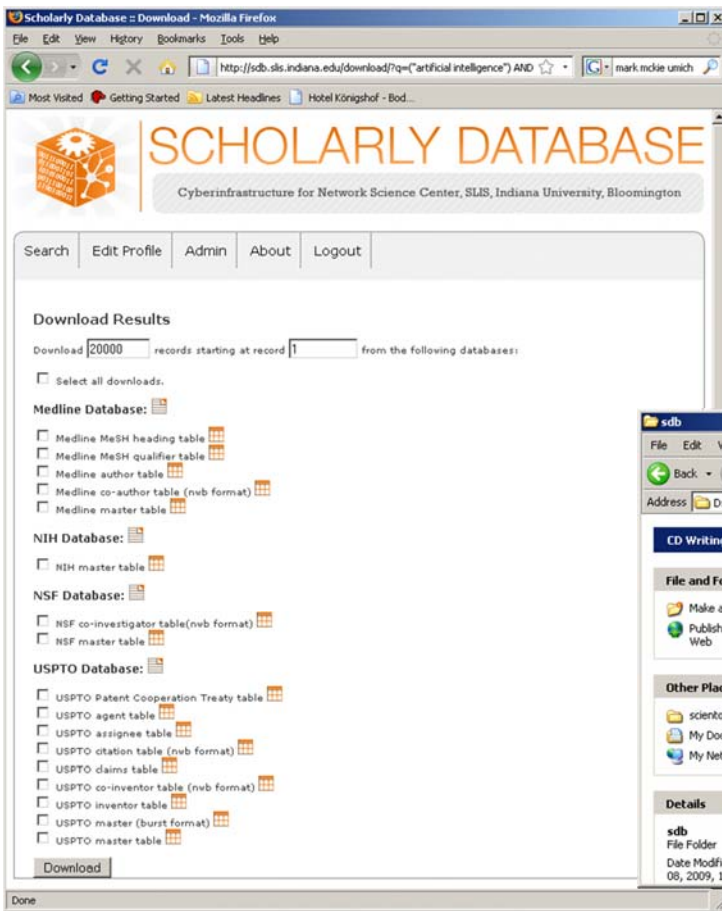
Results can be downloaded as data dump and (evolving) co-author, paper-citation networks.

The image shows two screenshots of the Scholarly Database website. The left screenshot displays the login page with options for 'IU User' and 'Non-IU User'. The 'IU User' section includes a 'Go to IU Login' button, while the 'Non-IU User' section has fields for 'Email' and 'Password' with a 'Login' button. Below the login options, there is a 'Not Registered Yet?' section with a 'Register as an IU User' link and a 'Register as a Non-IU User' link. The right screenshot shows the search interface with a search bar, navigation tabs (Search, Edit Profile, Admin, About, Logout), and a search form. The search form includes fields for 'Creators', 'Title', 'Abstract' (containing 'RNAi'), 'Full Text', 'First Year' (1898), and 'Last Year' (2008). There are also checkboxes for 'Medline (1898 - 2008)', 'NIH (1961 - 2002)', 'NSF (1985 - 2004)', and 'USPTO (1976 - 2007)'. A 'Search' button is at the bottom of the form. To the right of the search form, there is explanatory text about search syntax, such as using 'OR' for multiple terms, 'AND' for combining terms, and double quotes for exact phrases.

Register for free access at <http://sdb.cns.iu.edu>

The image is a screenshot of a Mozilla Firefox browser window displaying the Scholarly Database search results page. The browser's address bar shows the URL: [http://sdb.sls.indiana.edu/search/results?q=\(\"artificial intelligence\"\)](http://sdb.sls.indiana.edu/search/results?q=(\). The page header features the Scholarly Database logo and the text 'Cyberinfrastructure for Network Science Center, SLIS, Indiana University, Bloomington'. Below the header is a navigation menu with 'Search', 'Edit Profile', 'Admin', 'About', and 'Logout'. The main content area is titled 'Browse Results' and displays the search results for 'artificial intelligence'. It states: 'Your search returned 13,231 results in 0.295 seconds.' and includes a 'Download' button. Below this, it shows 'Total results per database: NIH: 2,103, Medline: 10,235, USPTO: 279, NSF: 614.' The results are listed from 1 through 20. The first five results are shown in a table:

Source	Authors/Creators	Year	Title	Score (out of 5.71)
Medline	LaCombe	1987	Artificial intelligence.	5.71
Medline		1989	Artificial intelligence: expert systems.	5.71
Medline	Schmitt	1990	[Artificial intelligence in dentistry]	5.71
Medline	Adlassnig and Adlassnig	2002	Artificial-intelligence-augmented systems.	5.60
Medline	Touretzky	1980	Artificial intelligence.	4.86
Medline	Goldenberg	1980	Artificial intelligence.	4.86

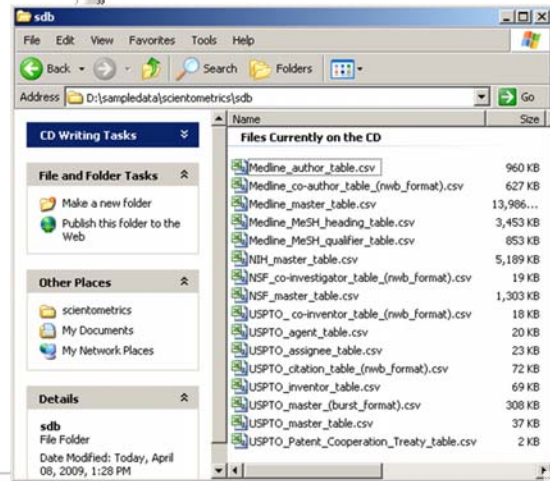


Since March 2009:

Users can download networks:

- Co-author
- Co-investigator
- Co-inventor
- Patent citation

and tables for burst analysis in NWB.



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OSGi/CIShell Adoption

A number of other projects recently adopted OSGi and/or CIShell:

USA

- *Cytoscape* (<http://cytoscape.org>) Led by Trey Ideker at the University of California, San Diego 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).
- *MAEviz* (<https://wiki.ncsa.uiuc.edu/display/MAE/Home>) Managed by Jong Lee at NCSA is an open-source, extensible software platform which supports seismic risk assessment based on the Mid-America Earthquake (MAE) Center research.

Europe

- *Taverna Workbench* (<http://taverna.org.uk>) Developed by the myGrid team (<http://mygrid.org.uk>) led by Carol Goble at the University of Manchester, U.K. 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.
 - *TEXTrend* (<http://textrend.org>) Led by George Kamps at Eötvös Loránd University, Budapest, Hungary supports natural language processing (NLP), classification/mining, and graph algorithms for the analysis of business and governmental text corpuses with an inherently temporal component.
 - *DynaNets* (<http://www.dynanets.org>) Coordinated by Peter M.A. Sloot at the University of Amsterdam, The Netherlands develops algorithms to study evolving networks.
 - *SISOB* (<http://sisob.lcc.uma.es>) An Observatory for Science in Society Based in Social Models.
- 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.

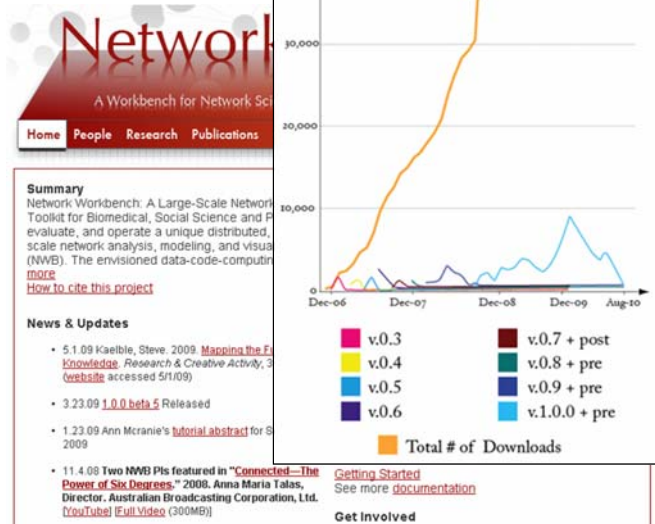
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The Network Workbench (NWB) tool supports researchers, educators, and practitioners interested in the study of biomedical, social and behavioral science, physics, and other networks.

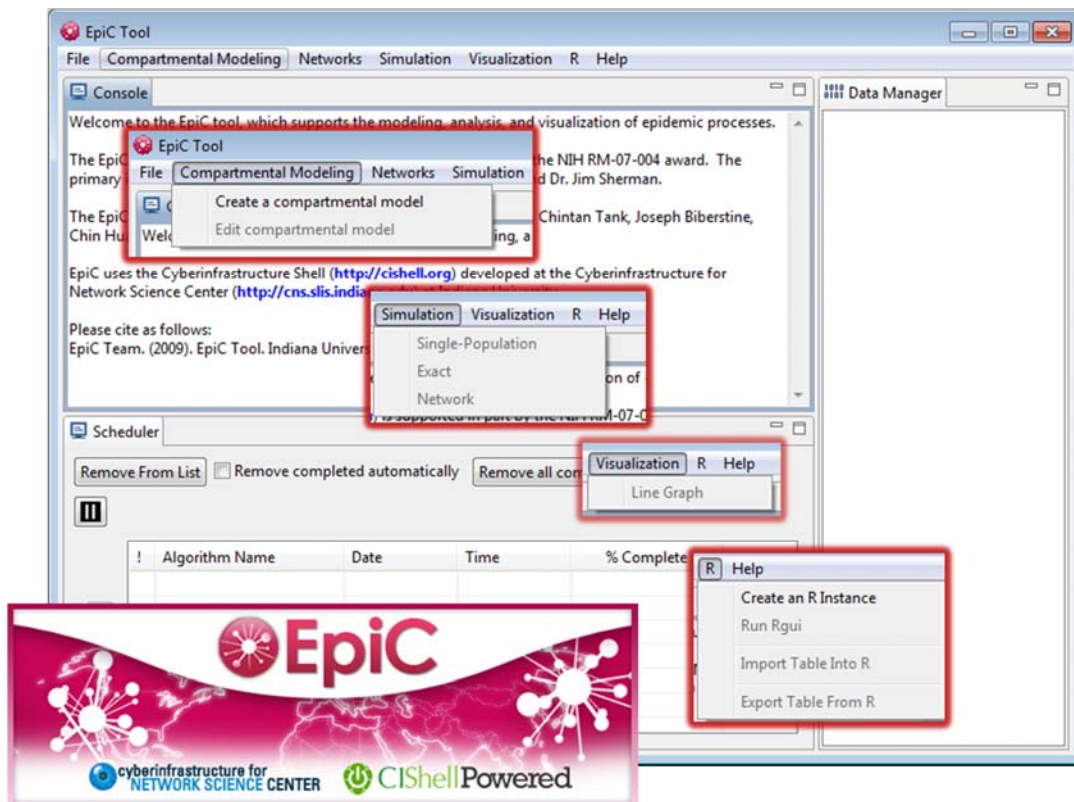
In February 2009, the tool provides more than 169 plugins that support the preprocessing, analysis, modeling, and visualization of networks.

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

It has been downloaded more than 125,000 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.



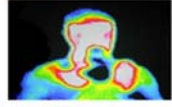

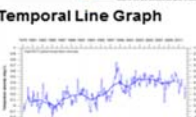
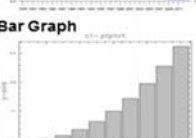
TEXTrend adds R bridge, WEKA, Wordjij, CFinder, and more.

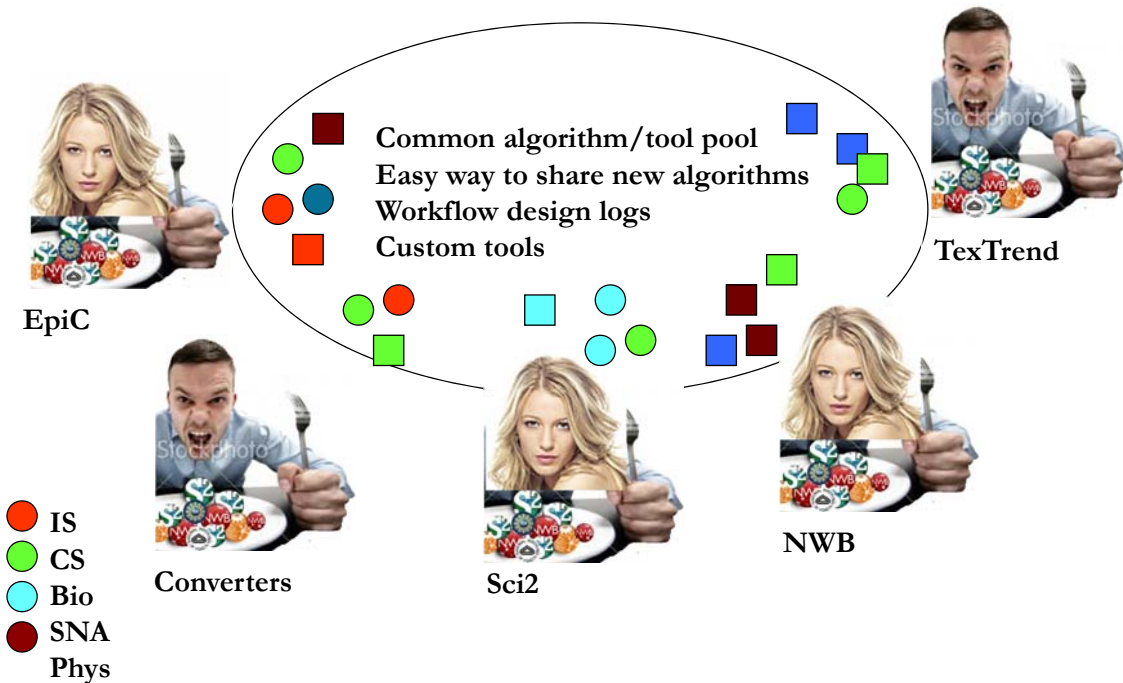
See the latest versions of TEXTrend Toolkit modules at

http://textrend.org/index.php?option=com_content&view=article&id=47&Itemid=53

NIH Proposal: Multi-Scale Mining and Visualization of Human Development

Katy Börner and Chin Hua Kong, SLIS; Linda Smith, Chen Yu, John Bates, Psychology and Brain Sciences, Indiana University

Data Collection / Integration	Data Exploration	Statistical Analysis	Visualization
<p>Time Series Data</p> <ul style="list-style-type: none"> Video taping Voice recording Eye tracking Motion tracking Brain signals <p>Output</p> <ul style="list-style-type: none"> Time series with numerical values Time series with categorical values Temporal events <p>Non-Time Series Data</p> <ul style="list-style-type: none"> Corpora Survey Manually code behavior Online data collection DNA sampling <p>Output</p> <ul style="list-style-type: none"> Raw text SPSS CSV 	<p>Time Series</p> <ul style="list-style-type: none"> Data coding Video coding Exploring behavior Generating events of interest Detecting overlaps Extracting streams Labeling Merging Cleaning Reverse ranking Synchronize time series from different levels and with different sampling rates Integrate heterogeneous datasets <p>Tools</p> <ul style="list-style-type: none"> OpenShapa Elan MapShapa NetStation Matlab SPSS Excel R <p>Output</p> <ul style="list-style-type: none"> Spread sheet Text CSV 	<p>Using Programming Languages / Scripting</p> <p>Time Analysis</p> <ul style="list-style-type: none"> Order Duration High / low frequency Direct object relation Intensity Window with different time scales <p>Word Analysis</p> <ul style="list-style-type: none"> Word association Vocabulary (noun / verb) Word structure Word co-occurrence <p>Factor Analysis</p> <p>Modeling Analysis</p> <p>Tools</p> <ul style="list-style-type: none"> Matlab R MPlus WordNet HLM Twist <p>Output</p> <ul style="list-style-type: none"> CSV TSV 	<p>Using Programming Languages / Scripting</p> <p>Heat Map</p>  <p>Network Graph</p>  <p>Temporal Line Graph</p>  <p>Bar Graph</p> 
3 Months to Years	1 to 6 Months	1 to 6 Months	1 to 6 Months
Research Timeline			



About the Cyberinfrastructure Shell

The Cyberinfrastructure Shell (CIShell) is an open source, community-driven platform for the integration and utilization of datasets, algorithms, tools, and computing resources. Algorithm integration support is built in for Java and most other programming languages. Being Java based, it will run on almost all platforms. The software and specification is released under an Apache 2.0 License.

CIShell is the basis of [Network Workbench](#), [TexTrend](#), [Sci2](#) and the upcoming [EpiC](#) tool.

CIShell supports remote execution of algorithms. A standard web service definition is in development that will allow pools of algorithms to transparently be used in a peer-to-peer, client-server, or web front-end fashion.

CIShell Features

A framework for easy integration of new and existing algorithms written in any programming language

Using CIShell, an algorithm writer can fully concentrate on creating their own algorithm in whatever language they are comfortable with. Simple tools are provided to then take their algorithm and

Learn More...

- [CIShell Papers](#)
- [CIShell Powered Tools](#)
- [Algorithms](#)
- [Plugins \(coming soon\)](#)
- [Misc. Tool Documentation](#)
- CIShell Web Services (coming soon)
- [Screenshots](#)

Getting Started...

- [Documentation & Developer Resources](#)
- [Download](#)

Getting Involved...

- [Contact Us](#)

CIShell Developer Guide is at <http://cishell.wiki.cns.iu.edu>

Additional Sci2 Plugins are at <http://sci2.wiki.cns.iu.edu/3.2+Additional+Plugins>

- The file `yourtooldirectory/configuration/default_menu.xml` encodes the structure of the menu system.
- In NWB Tool, the Modeling menu (left) is encoded by the following piece of xml code:

```

<top_menu name="Modeling">
<menu pid="edu.iu.nwb.modeling.erdosrandomgraph"/>
<menu pid="edu.iu.nwb.modeling.smallworld"/>
<menu pid="edu.iu.nwb.modeling.barabasiAlbert"/>
<menu type="break"/>
<menu pid="edu.iu.iv.modeling.p2p.can.CanAlgorithm"/>
<menu pid="edu.iu.iv.modeling.p2p.chord.ChordAlgorithm"/>
<menu pid="edu.id.iv.modeling.p2p.hypergrid.Hypergrid"/>
<menu pid="edu.iu.iv.modeling.p2p.pru.PruAlgorithm"/>
<menu type="break"/>
<menu pid="edu.iu.iv.modeling.tarl.TarlAlgorithm"/>
<menu type="break"/>
<menu pid="edu.iu.nwb.modeling.discretenetworkdynamics.DNDAlgorithm"/>
<menu type="break"/>
<menu pid="edu.iu.nwb.modeling.weighted.evolvingnetwork"/>
</top_menu>

```



Need Help? Ask an Expert!

Sci² Tool
A Tool for Science of Science Research & Practice

Home Download Documentation **Ask An Expert** Testimonials Developers

Ask An Expert

(If you need to report a bug for the Sci² tool instead, [click here](#).)

Project Title Pick any name to help us to refer to this project/question in the future.

Types of Analyses

- Temporal (When) ?
- Geospatial (Where) ?
- Topical (What) ?
- Modeling (Why) ?
- Networks (With Whom?) ?

Levels of Analyses

- Micro/Individual (1-100 records) ?
- Meso/Local (101-10,000 records) ?
- Macro/Global (> 10,000 records) ?

Intended Users Who is the intended audience?
Who is interested in the result?

Insight Needed What would you/user like to understand?

[View sample questions HERE](#)
(Will open in new tab.)

<https://sci2.cns.iu.edu/user/ask.php>

References

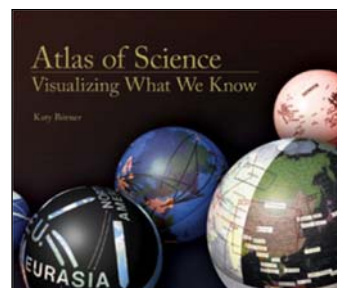
Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003). **Visualizing Knowledge Domains**. In Blaise Cronin (Ed.), *ARIST*, Medford, NJ: Information Today, Volume 37, Chapter 5, pp. 179-255.
<http://ivl.slis.indiana.edu/km/pub/2003-borner-arist.pdf>

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/

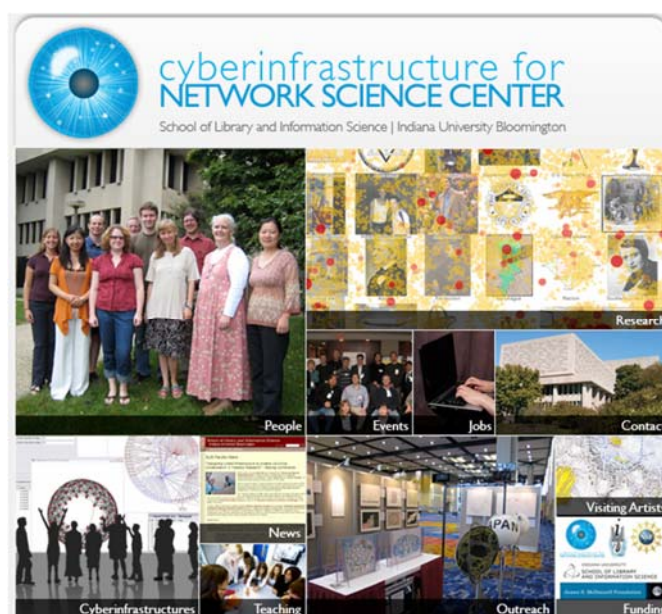
Börner, Katy, Sanyal, Soma and Vespignani, Alessandro (2007). **Network Science**. In Blaise Cronin (Ed.), *ARIST*, Information Today, Inc., Volume 41, Chapter 12, pp. 537-607.
<http://ivl.slis.indiana.edu/km/pub/2007-borner-arist.pdf>

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

Scharnhorst, Andrea, Börner, Katy, van den Besselaar, Peter (2012) **Models of Science Dynamics**. Springer Verlag.



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All papers, maps, tools, talks, press are linked from <http://cns.iu.edu>

CNS Facebook: <http://www.facebook.com/cnscenter>

Mapping Science Exhibit Facebook: <http://www.facebook.com/mappingscience>

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