Science of Science Research and Tools
Tutorial #03 of 12

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With special thanks to Kevin W. Boyack, Micah Linnemeier, Russell J. Duhon, Patrick Phillips, Joseph Biberstine, Chintan Tank Nianli Ma, Hanning Guo, Mark A. Price, Angela M. Zoss, and Scott Weingart

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10a-noon, July 8, 2010

12 Tutorials in 12 Days at NIH—Overview

1. Science of Science Research — **1st Week**
2. Information Visualization
3. **CIShell Powered Tools: Network Workbench and Science of Science Tool**

4. **Temporal Analysis—Burst Detection** — **2nd Week**
5. **Geospatial Analysis and Mapping**
6. **Topical Analysis & Mapping**

7. **Tree Analysis and Visualization** — **3rd Week**
8. **Network Analysis**
9. **Large Network Analysis**

10. **Using the Scholarly Database at IU** — **4th Week**
11. **VIVO National Researcher Networking**
12. **Future Developments**

12 Tutorials in 12 Days at NIH—Overview

[#03] CIShell Powered Tools: Network Workbench and Science of Science Tool

- Using a Million Minds to Build Custom Tools
- Open Service Gateway Initiative (OSGi)
- Cyberinfrastructure Shell (CIShell)
- **Network Workbench (NWB) Tool**
- **Science of Science (Sci2) Tool**
- Adding Plugins to CIShell Powered Tools
- Promising Research Directions

Recommended Reading

- Herr, Bruce W., Huang, Weixia, Penumarthy, Shashikant, Börner, Katy . (2007) Designing Highly Flexible and Usable Cyberinfrastructures for Convergence. In William S. Bainbridge and Mihail C. Roco (Eds.) *Progress in Convergence – Technologies for Human Wellbeing. Annals of the New York Academy of Sciences*, Boston, MA, volume 1093, pp. 161-179. http://cishell.org/papers/06-cishell.pdf
- Cyberinfrastructure Shell home page, http://cishell.org.
- Network Workbench (NWB) Tool home page, http://nwb.slis.indiana.edu
- Science of Science (Scii2) Tool home page, http://sci.slis.indiana.edu/sci2

[#03] CIShell Powered Tools:

Network Workbench and Science of Science Tool

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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).

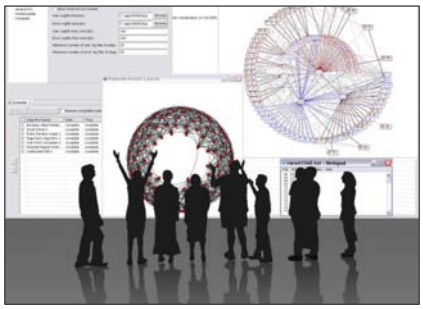
Cross-disciplinary: The best tools frequently borrow and synergistically combine methods and techniques from different disciplines of science and empower interdisciplinary and/or international teams of researchers, practitioners, or educators to fine-tune and interpret results collectively.

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.

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

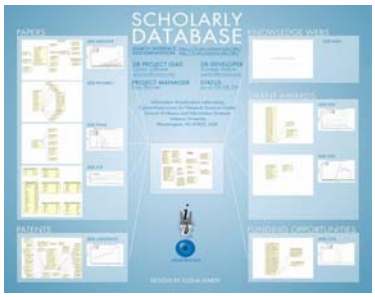
Epidemics Cyberinfrastructure
http://epic.slis.indiana.edu/

180+ Algorithm Plugins and Branded GUIs
+
Core Architecture

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

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

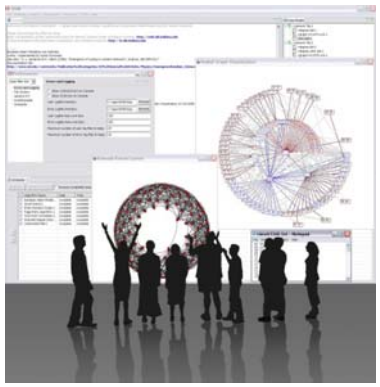
Computational Scientometrics CI



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

James S. McDonnell Foundation

VIVO Research Networking
http://vivoweb.org



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

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

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

Epidemics Cyberinfrastructure
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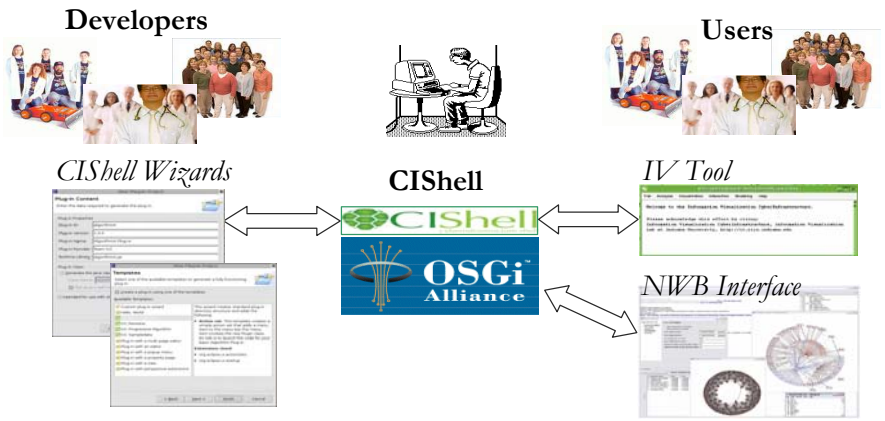
Cyberinfrastructure Shell (CIShell)

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.



CIShell – Builds on OSGi Industry Standard

CIShell is built upon the Open Services Gateway Initiative (OSGi) Framework.

OSGi (http://www.osgi.org) is

- A standardized, component oriented, computing environment for networked services.
- Successfully used in the industry from high-end servers to embedded mobile devices since 8 years.
- Alliance members include IBM (Eclipse), Sun, Intel, Oracle, Motorola, NEC and many others.
- Widely adopted in open source realm, especially since Eclipse 3.0 that uses OSGi R4 for its plugin model.

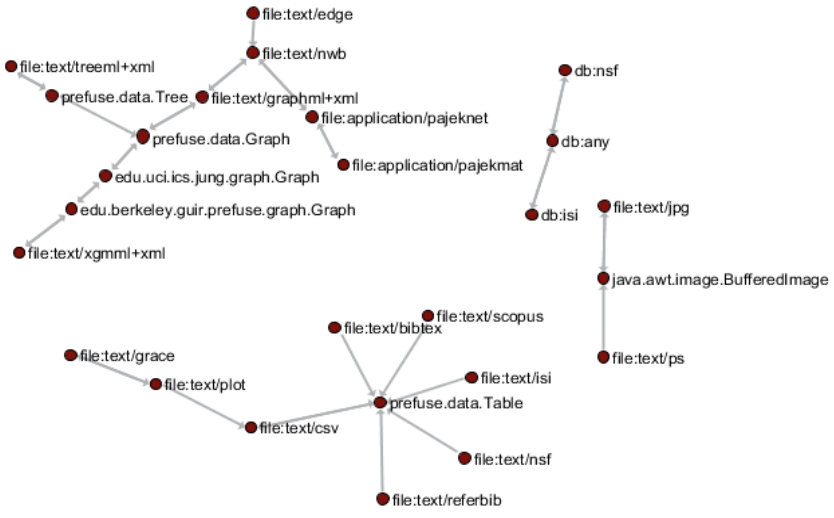
Advantages of Using OSGi

- Any CIShell algorithm is a service that can be used in any OSGi-framework based system.
- Using OSGi, running CIShells/tools can connected via RPC/RMI supporting peer-to-peer sharing of data, algorithms, and computing power.

Ideally, CIShell becomes a standard for creating OSGi Services for algorithms.

CIShell – Converter Graph

- No central data format.
- Sci^2 Tool has 26 external and internal data formats and 35 converters.
- Their relationships can be derived by running 'File > Converter Graph' and plotted as shown here. Note that some conversions are symmetrical (double arrow) while others are one-directional (arrow).



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Network Workbench Tool

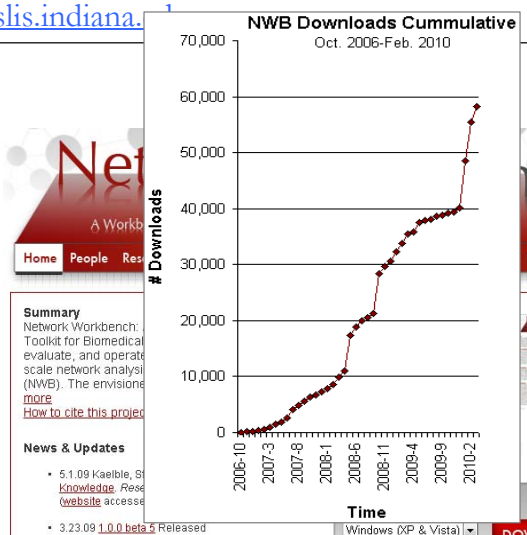
http://nwb.slis.indiana.

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.



Börner, Katy, Huang, Weixia (Bonnie), Linnemeier, Micah, Duhon, Russell Jackson, Phillips, Patrick, Ma, Nianli, Zoss, Angela, Guo, Hanning & Price, Mark. (2010). Rete-Netzwerk-Red: Analyzing and Visualizing Scholarly Networks Using the Network Workbench Tool. Scientometrics. Vol. 83(3), 863-876.

Project Details

Investigators: Katy Börner, Albert-Laszlo Barabasi, Santiago Schnell, Alessandro Vespignani & Stanley Wasserman, Eric Wernert

Software Team: Lead: Micah Linnemeier
Members: Patrick Phillips, Russell Duhon, Tim Kelley & Ann McCranie
Previous Developers: Weixia (Bonnie) Huang, Bruce Herr, Heng Zhang, Duygu Balcan, Bryan Hook, Ben Markines, Santo Fortunato, Felix Terkhorn, Ramya Sabbineni, Vivek S. Thakre & Cesar Hidalgo

Goal: Develop a large-scale network analysis, modeling and visualization toolkit for physics, biomedical, and social science research.

Amount: $1,120,926, NSF IIS-0513650 award

Duration: Sept. 2005 - Aug. 2009

Website: http://nwb.slis.indiana.edu

Project Details (cont.)

NWB Advisory Board:

James Hendler (Semantic Web) http://www.cs.umd.edu/~hendler/
Jason Leigh (CI) http://www.evl.uic.edu/spiff/
Neo Martinez (Biology) http://online.sfsu.edu/~webhead/
Michael Macy, Cornell University (Sociology) http://www.soc.cornell.edu/faculty/macy.shtml
Ulrik Brandes (Graph Theory) http://www.inf.uni-konstanz.de/~brandes/
Mark Gerstein, Yale University (Bioinformatics) http://bioinfo.mbb.yale.edu/
Stephen North (AT&T) http://public.research.att.com/viewPage.cfm?PageID=81
Tom Snijders, University of Groningen http://stat.gamma.rug.nl/snijders/
Noshir Contractor, Northwestern University http://www.spcomm.uiuc.edu/nosh/

Computational Proteomics

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

Yildrüm, 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.

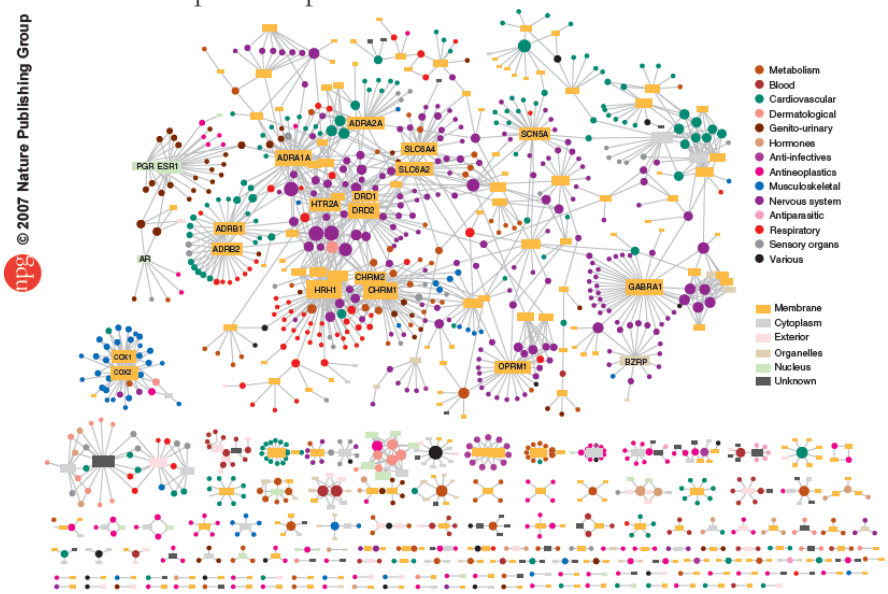


Figure 2 Drug–target network (DT network). The DT network is generated by using the known associations between FDA-approved drugs and their target proteins. Circles and rectangles correspond to drugs and target proteins, respectively. A link is placed between a drug node and a target node if the protein 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).

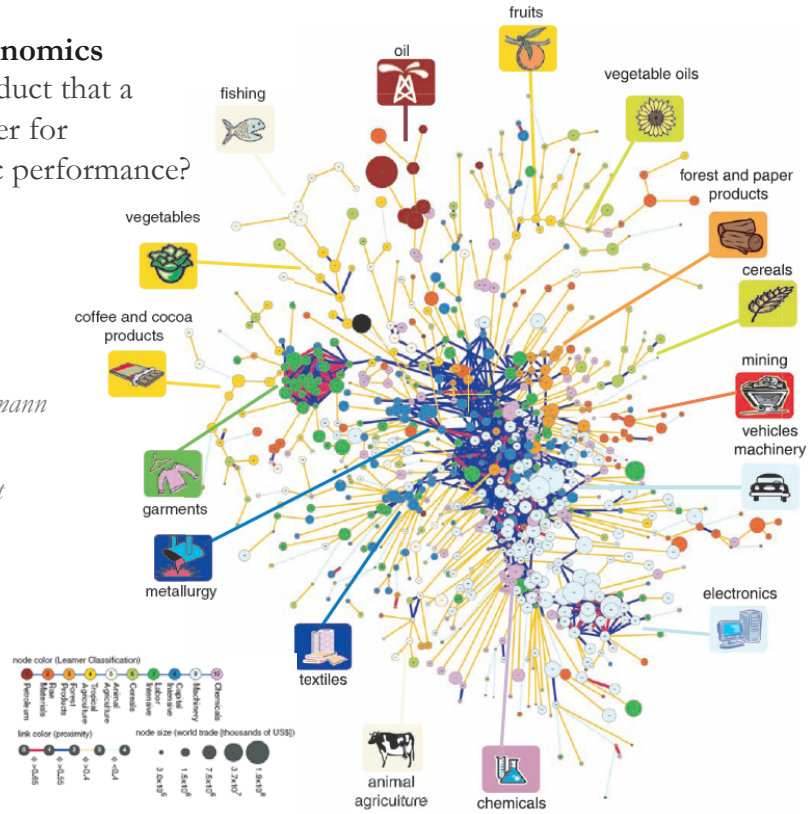
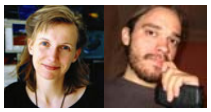
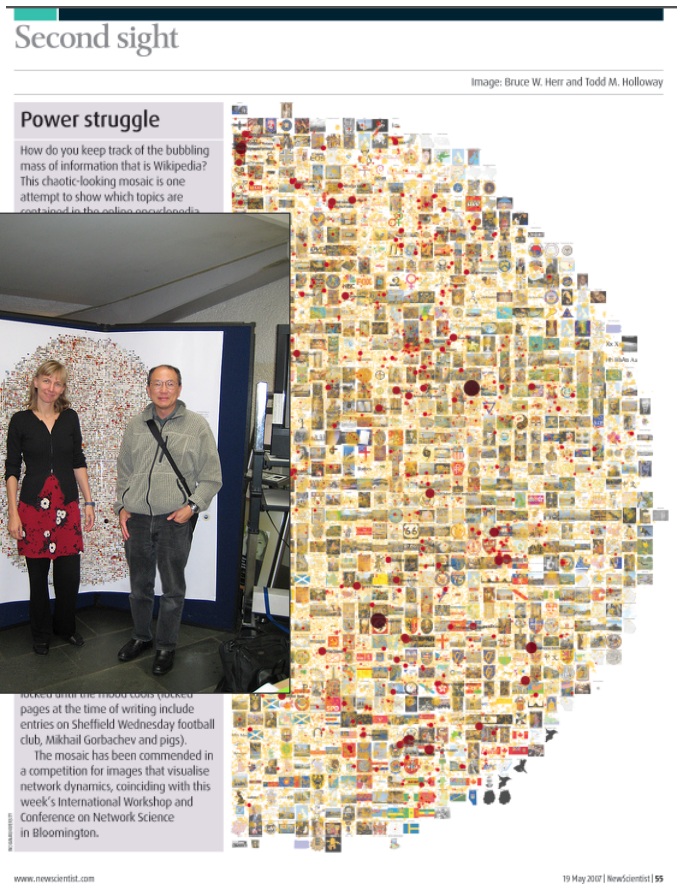


Fig. 1. The product space. **(A)** Hierarchically clustered proximity (ϕ) matrix representing the 775 SITC-4 product classes exported in the 1998–2000 period. **(B)** Network representation of the product space. Links are color coded with their proximity value. The sizes of the nodes are proportional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

Computational Social Science
Studying large scale social networks such as Wikipedia

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

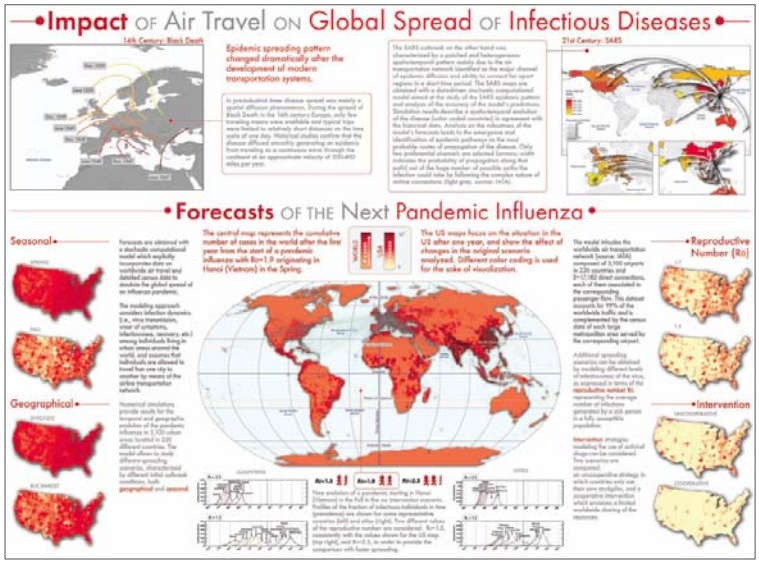




Computational Epidemics
Forecasting (and preventing the effects of) the next pandemic.

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 Download, Install, and Run

NWB Tool 1.0.0

Can be freely downloaded for all major operating systems from http://nwb.slis.indiana.edu

Select your operating system from the pull down menu and download.

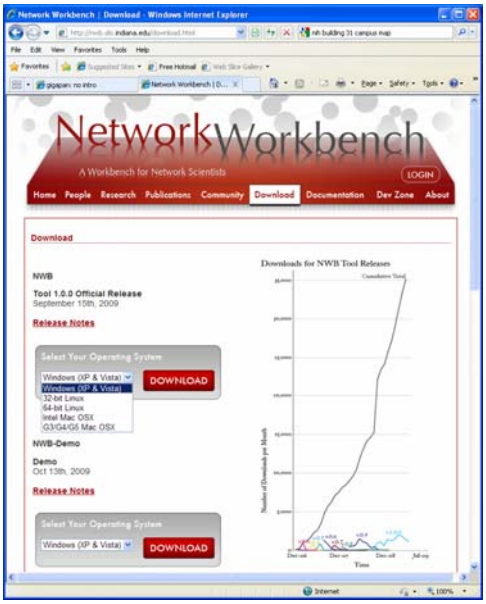
Unpack into a /nwb directory.

Run /nwb/nwb.exe

Session log files are stored in '**yournwbdirectory*/logs*' directory.

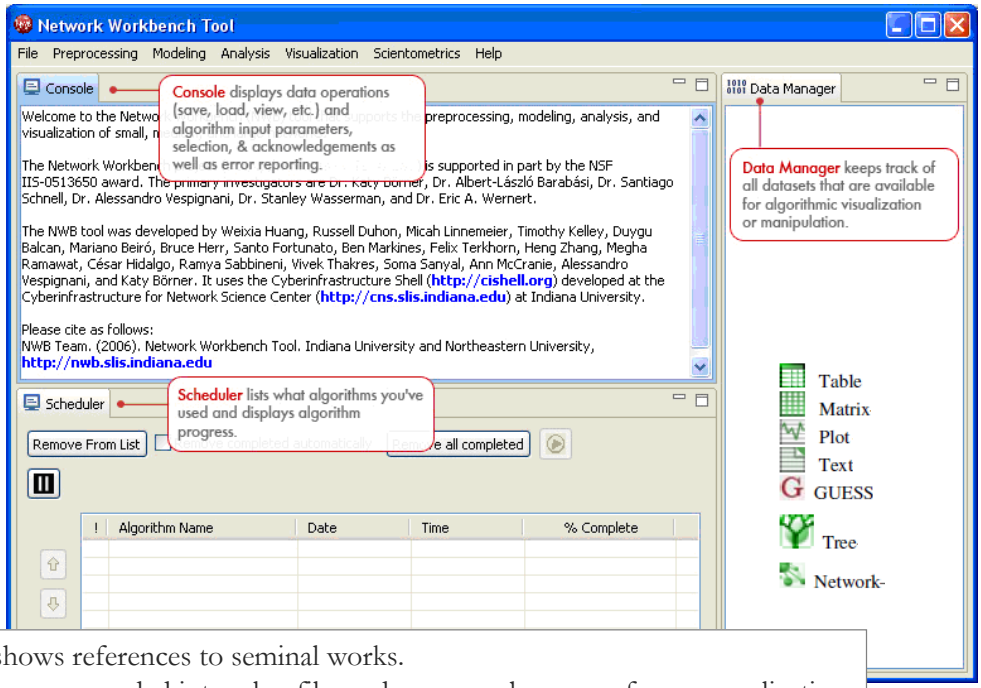
Cite as

NWB Team. (2006). Network Workbench Tool. Indiana University, Northeastern University, and University of Michigan, http://nwb.slis.indiana.edu.



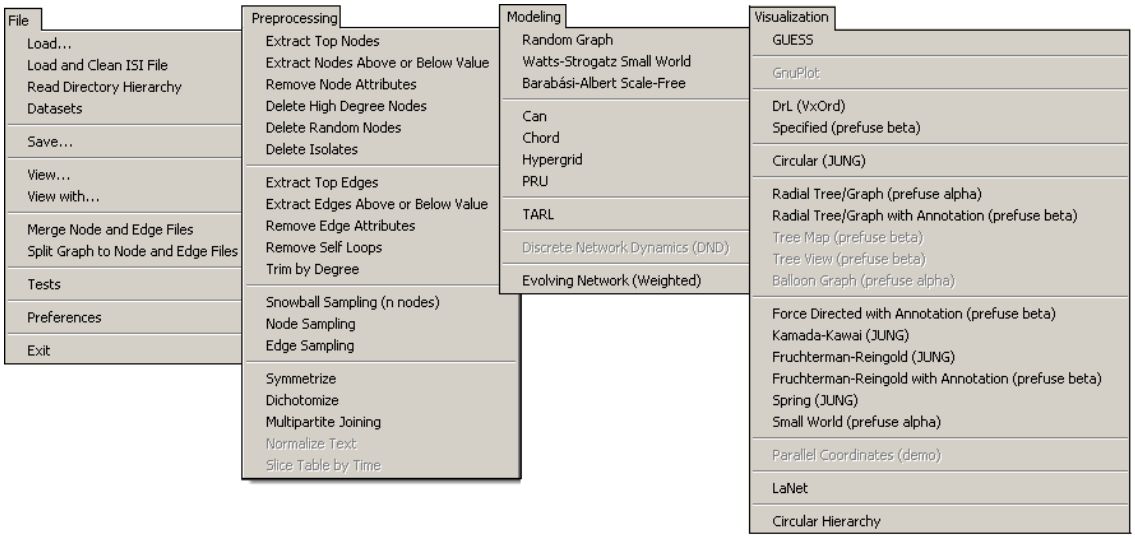
The file was also made available as nwb-N-1.0.0.200909181911NGT-win32.win32.x86.zip on the computers in the tutorial room.

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.

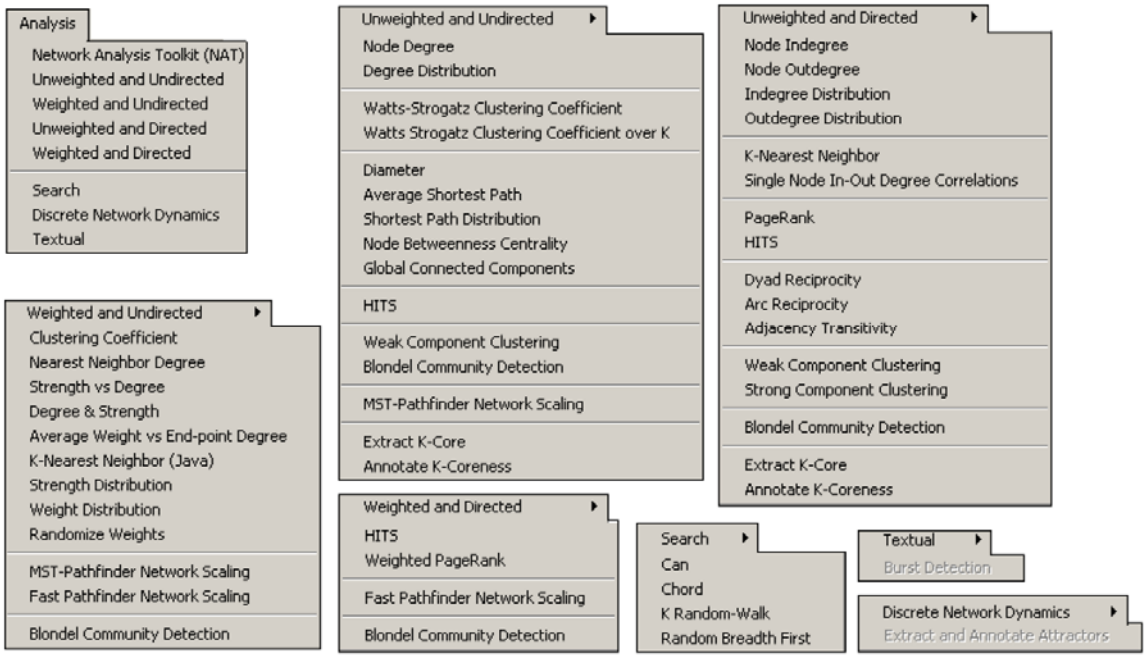
File, Preprocessing, Modeling, and Visualization Menus



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.

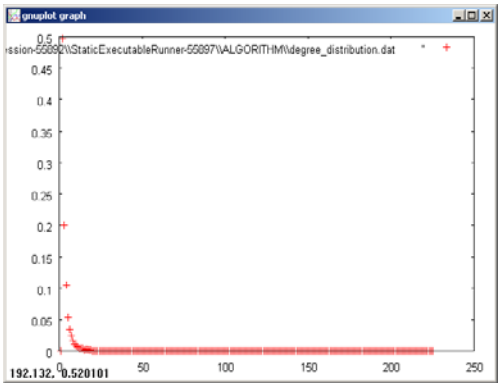
http://ivl.slis.indiana.edu/km/pub/2007-borner-arist.pdf

Analysis Menu and Submenus



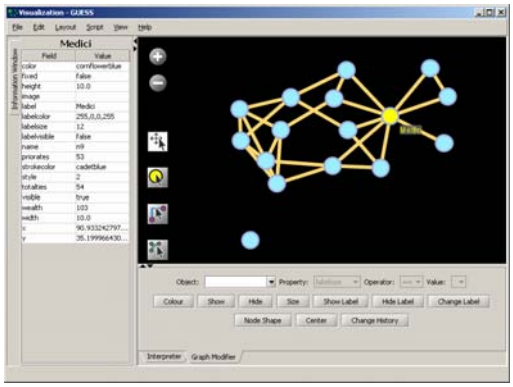
Börner, Katy, Sanyal, Soma and Vespignani, Alessandro (2007). **Network Science.** In Blaise Cronin (Ed.), *ARIST*, Information Today, Inc./American Society for Information Science and Technology, Medford, NJ, Volume 41, Chapter 12, pp. 537-607. http://ivl.slis.indiana.edu/km/pub/2007-borner-arist.pdf

Integrated Tools



Gnuplot

portable command-line driven interactive data and function plotting utility http://www.gnuplot.info/.



GUESS

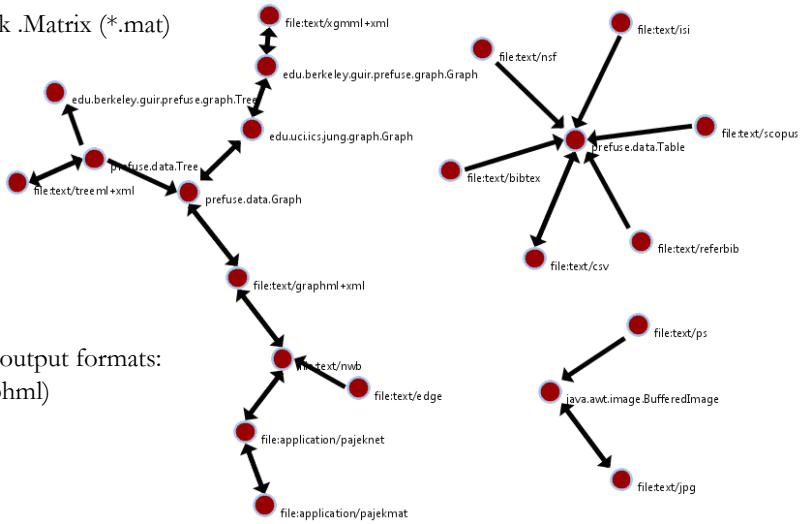
exploratory data analysis and visualization tool for graphs and networks.

https://nwb.slis.indiana.edu/community/?n=VisualizeData.GUESS.

Supported Data Formats

The NWB tool supports loading the following input file formats:

- GraphML (*.xml or *.graphml)
- XGMML (*.xml)
- Pajek .NET (*.net) & Pajek .Matrix (*.mat)
- NWB (*.nwb)
- TreeML (*.xml)
- Edge list (*.edge)
- CSV (*.csv)
- ISI (*.isi)
- Scopus (*.scopus)
- NSF (*.nsf)
- Bibtex (*.bib)
- Endnote (*.enw)



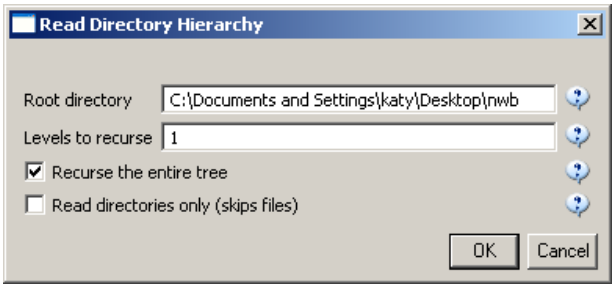
and the following network file output formats:

- GraphML (*.xml or *.graphml)
- Pajek .MAT (*.mat)
- Pajek .NET (*.net)
- NWB (*.nwb)
- XGMML (*.xml)
- CSV (*.csv)

Formats are documented at https://nwb.slis.indiana.edu/community/?n=DataFormats.HomePage.

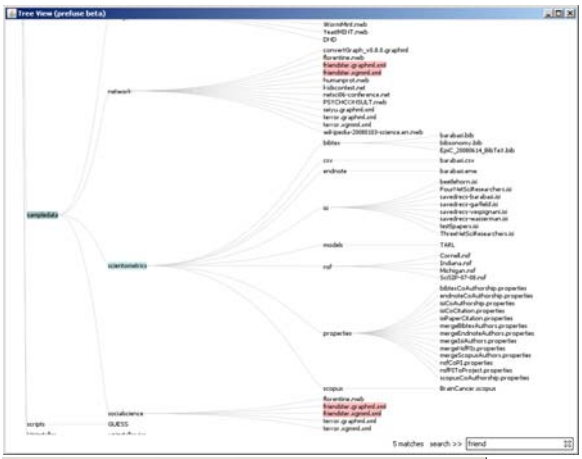
Reading and Visualizing a Directory Hierarchy

Use *'File > Read Directory Hierarchy'* with parameters



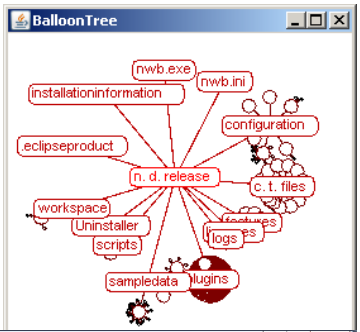
Visualize resulting *'Directory Tree - Prefuse (Beta) Graph'* using

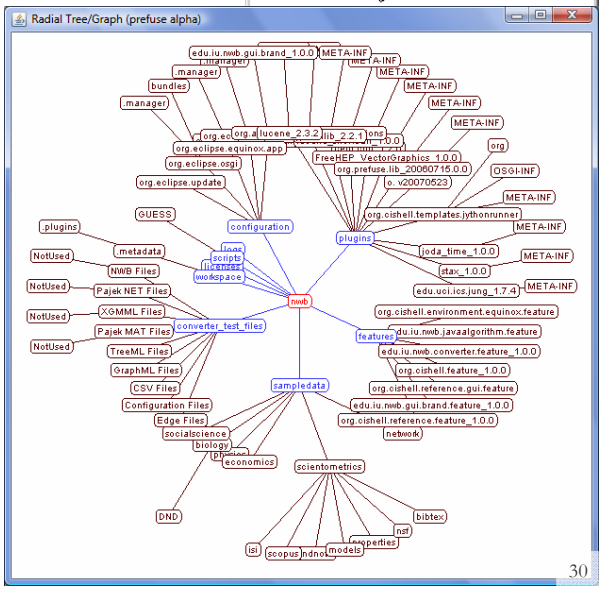
- *'Visualization > Tree View (prefuse beta)'*
- *'Visualization > Tree Map (prefuse beta)'*
- *'Visualization > Balloon Graph (prefuse alpha)'*
- *'Visualization > Radial Tree/Graph (prefuse alpha)'*



Different views of the /nwb directory hierarchy.

Note the size of the /plugin directory.





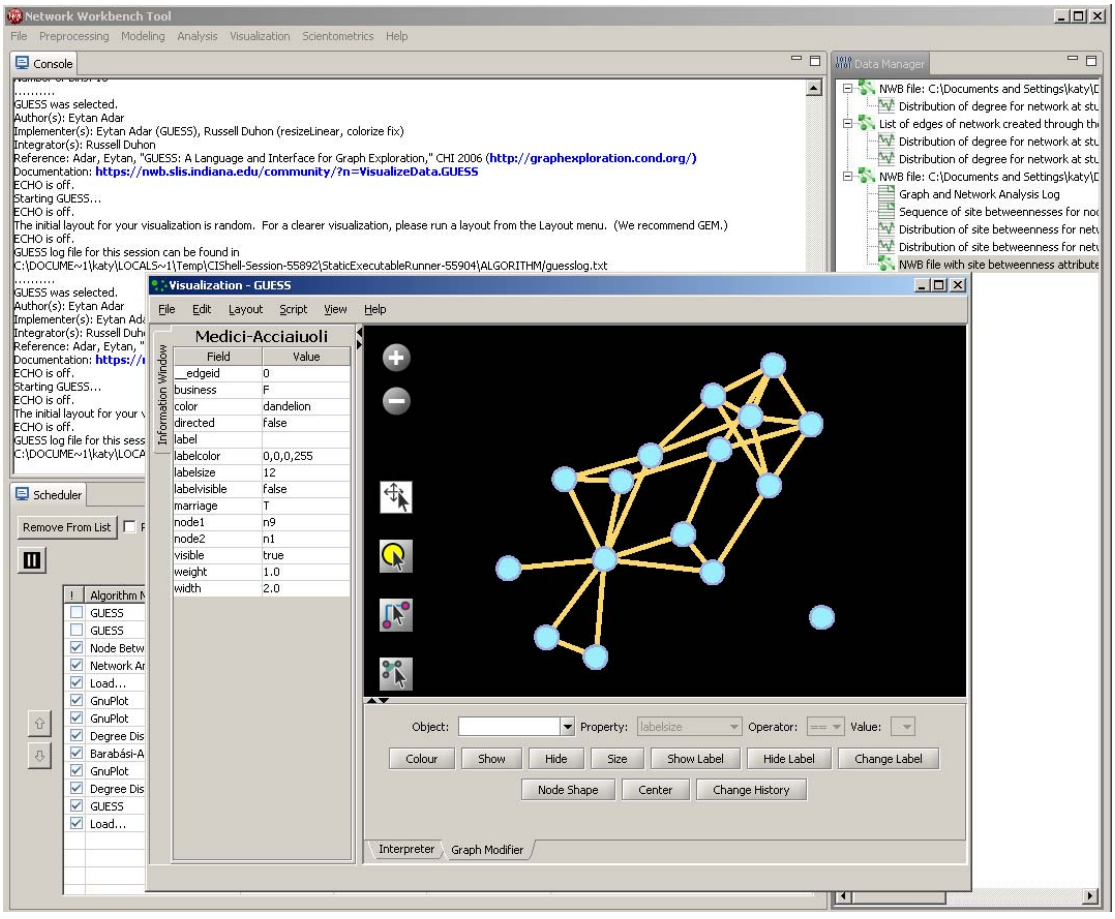
Compute Basic Network Properties & View in GUESS

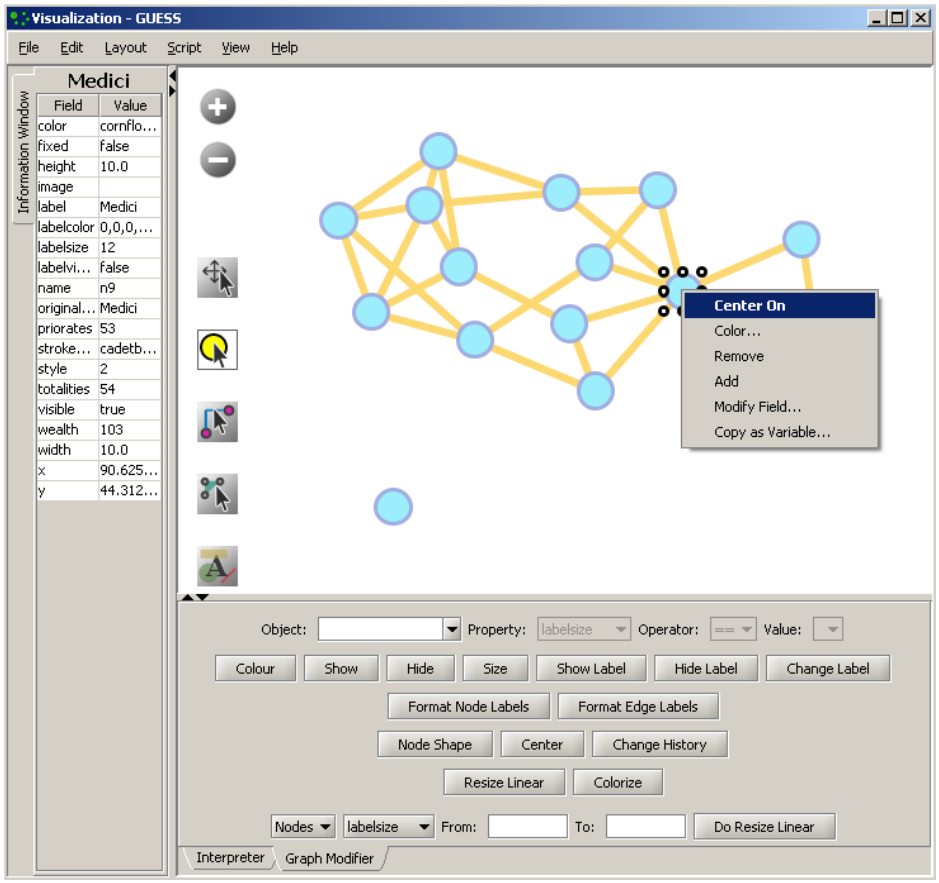
Select *florentine.nwb* in Data Manager.

- Run *'Analysis > Network Analysis Toolkit (NAT)'* to get basic properties.

```
This graph claims to be undirected.

Nodes: 16
Isolated nodes: 1
Node attributes present: label, wealth, totalties, priorates

Edges: 27
No self loops were discovered.
No parallel edges were discovered.
Edge attributes:
  Nonnumeric attributes:
                        Example value
        marriag...      T
        busines...      F

  Did not detect any numeric attributes
  This network does not seem to be a valued network.

Average degree: 3.375
This graph is not weakly connected.
There are 2 weakly connected components. (1 isolates)
The largest connected component consists of 15 nodes.
Did not calculate strong connectedness because this graph was not directed.

Density (disregarding weights): 0.225
```

- Optional: Run 'Analysis > Unweighted & Undirected > Node Betweenness Centrality' with default parameters.
- Select network and run *'Visualization > GUESS'* to open GUESS with file loaded.
- Apply 'Layout -> GEM'.





Pan:

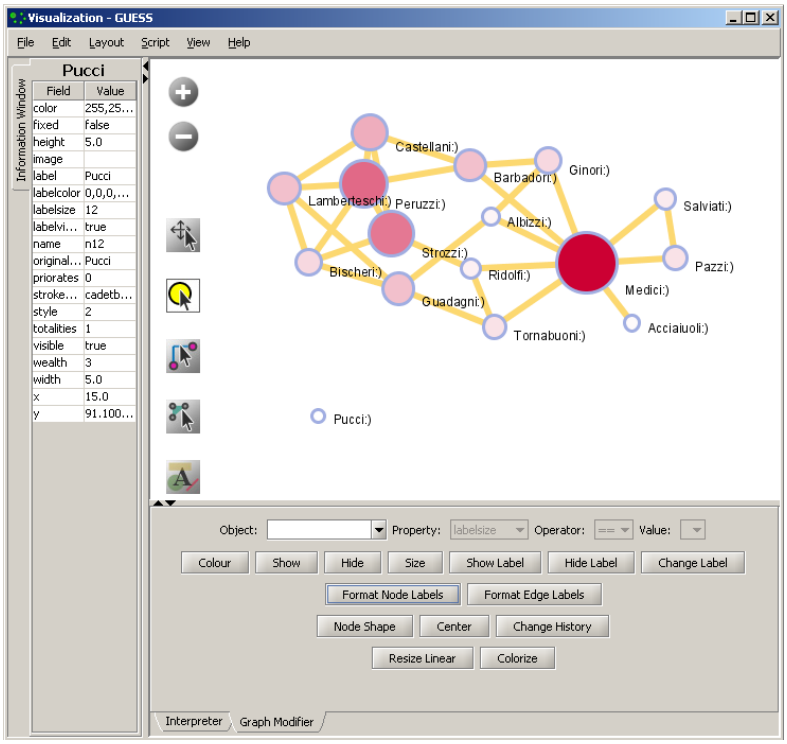
"grab" the background by holding left-click and moving your mouse.

Zoom:

Using scroll wheel, press the "+" and "-" buttons in the upper-left hand corner, or right-click and move the mouse left or right. Center graph by selecting 'View -> Center'.

Select  to select/move single nodes. Hold down 'Shift' to select multiple.

Right click to modify Color, etc.



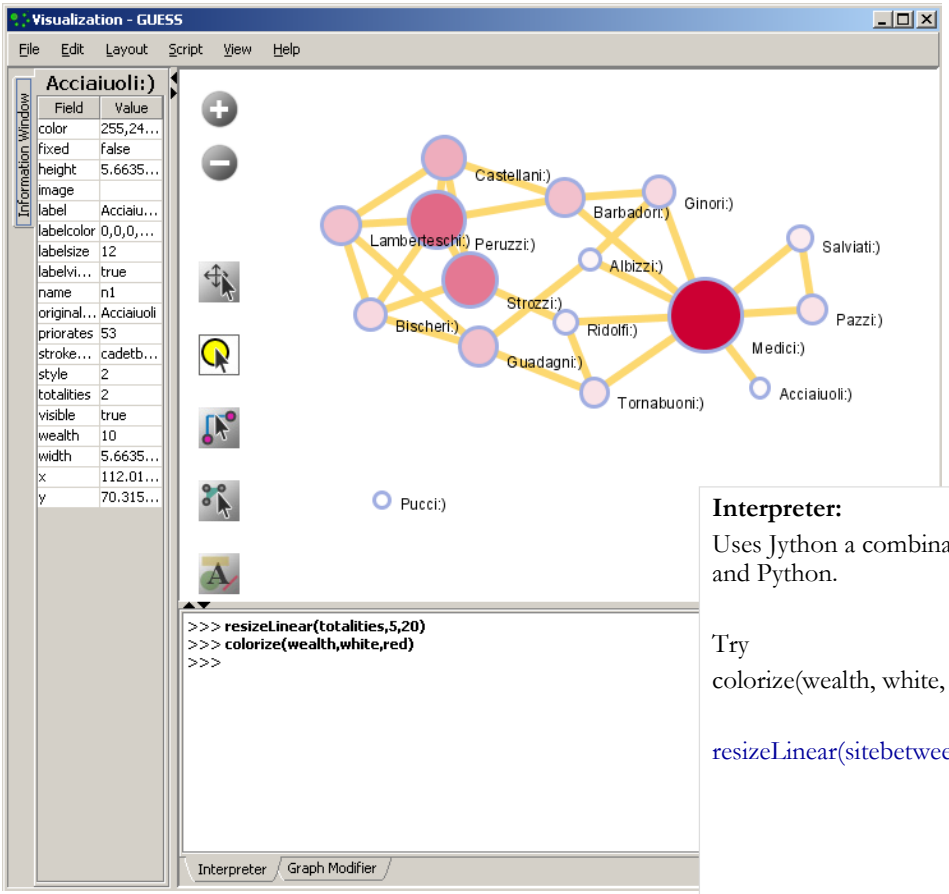
Graph Modifier:

Select "all nodes" in the Object drop-down menu and click 'Show Label' button.

Select 'Resize Linear > Nodes > totalities' drop-down menu, then type "5" and "20" into the From" and To" Value box separately. Then select 'Do Resize Linear'.

Select 'Colorize> Nodes>totalities', then select white and enter (204,0,51) in the pop-up color boxes on in the "From" and "To" buttons.

Select "Format Node Labels", replace default text {originallabel} with your own label in the pop-up box 'Enter a formatting string for node labels.'



Interpreter:

Uses Jython a combination of Java and Python.

Try

colorize(wealth, white, red)

resizeLinear(sitebetweenness, 5, 25)

[#03] CIShell Powered Tools:

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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

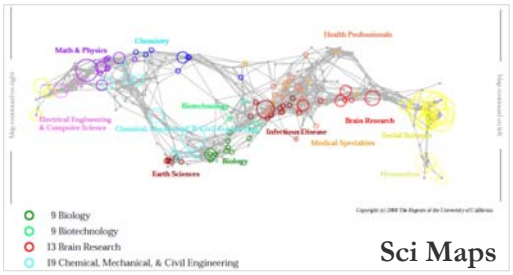
- Existing metrics have known flaws
- A reliable, open, joined-up data infrastructure is needed
- Data should be collected on the full range of scientists' work
- Social scientists and economists should be involved

Let's make science metrics more scientific

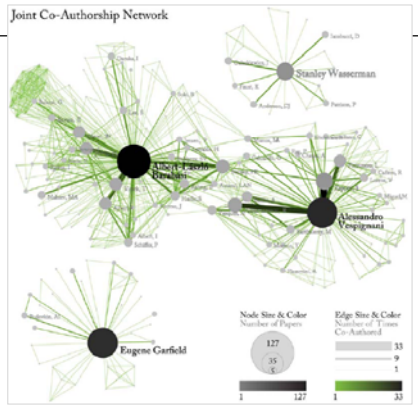
To capture the essence of good science, stakeholders must combine forces to create an open, sound and consistent system for measuring all the activities that make up academic productivity, says **Julia Lane**.

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

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



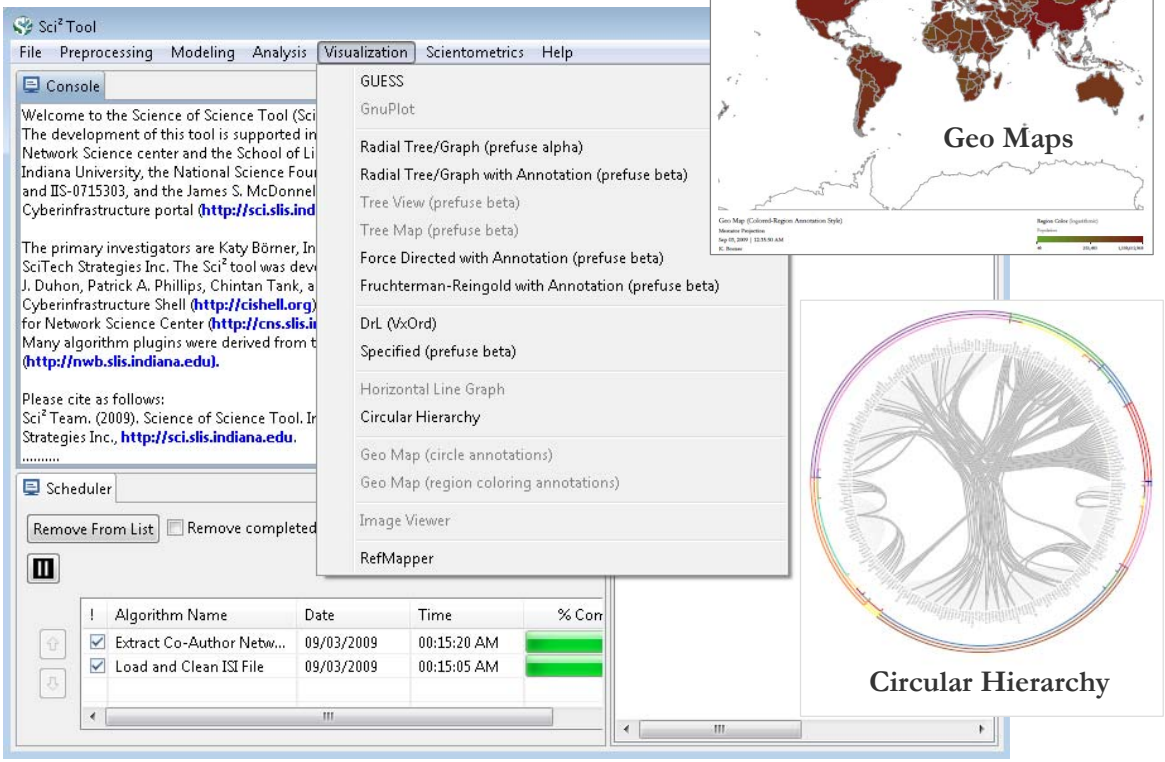
Sci Maps



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

NEW:
Database support for ISI and NSF data.

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)**

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

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

Sci² Tool: Download, Install, and Run

Sci² Tool Alpha 3 (March 2010)

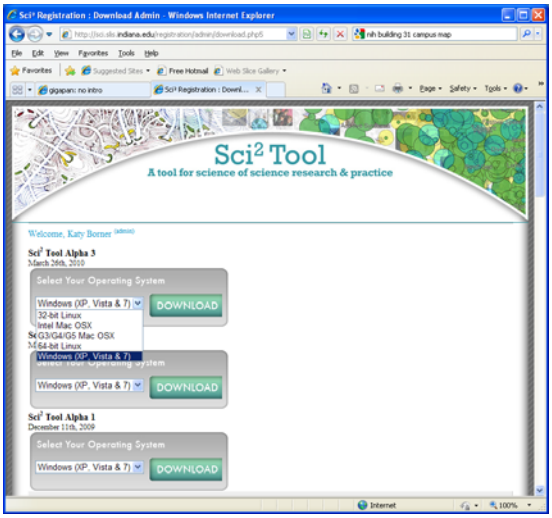
Can be freely downloaded for all major operating systems from
http://sci.slis.indiana.edu/sci2

Select your operating system from the pull down menu and download.

Unpack into a /sci2 directory.

Run /sci2/sci2.exe

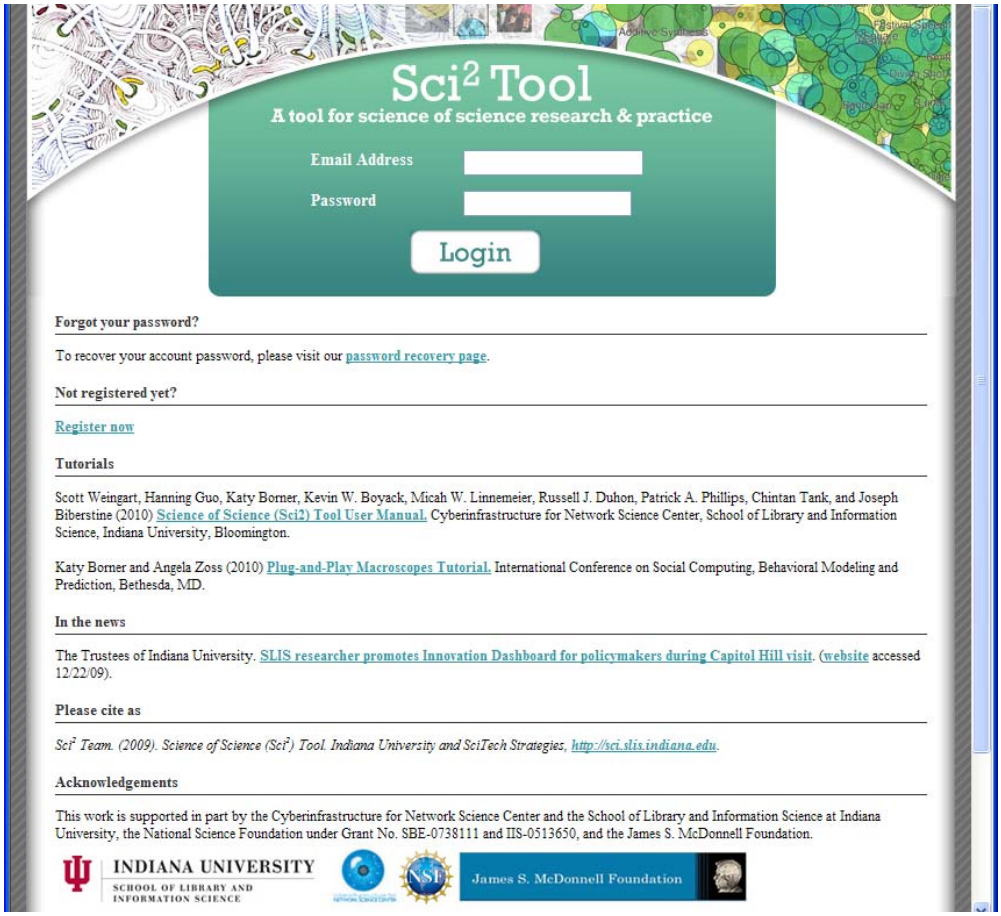
Session log files are stored in '**yournwbdirectory*/logs*' directory.



Cite as

Sci² Team. (2009). Science of Science (Sci²) Tool. Indiana University and SciTech Strategies, http://sci.slis.indiana.edu

The file was also made available as sci2-N-1.0.0.201003270106NGT-win32.win32.x86.zip on the computers in the tutorial room.



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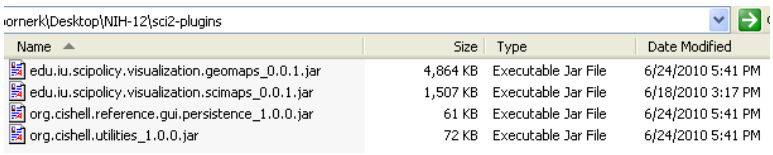
CIShell – Add new Plugins, e.g., UCSD Science Map

- Not all code can be shared freely (yet).
- To make the UCSD Science Map and new geomaps available via the Sci² menu, simply add



The files were made available in /sci2-plugins directory on the computers in the tutorial room.

to the '*yourdirectory/plugin*' directory and restart the tool.

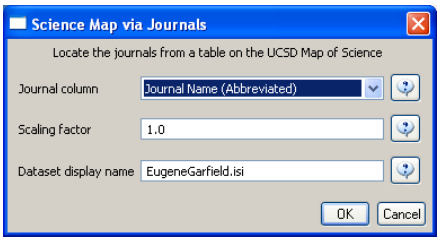
The rights to the UCSD map are owned by the Regents of UCSD. Usage does not require a separate, signed agreement or an additional request to our office if consistent with the permission. As a courtesy, please send information on how the map is being used to

William J. Decker, Ph.D., Associate Director, Technology Transfer Office
University of California, San Diego, 9500 Gilman Drive Dept. 0910, La Jolla, CA 92093
phone:858-822-5128, fax: 858-534-7345, e-mail: wjdecker@ucsd.edu

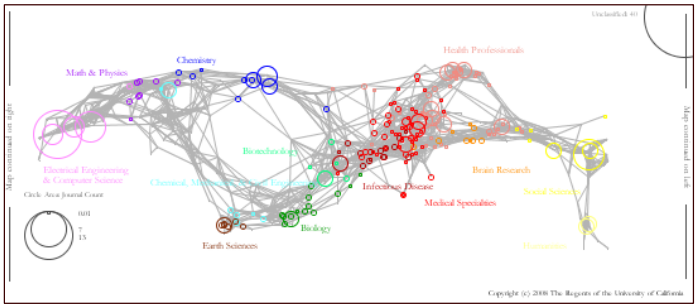
- To delete algorithms that you do not use, simply delete the corresponding *.jar files in the plugin directory.
- Customize your menu structure accordingly—see next slide.

CIShell – Add new Plugins, e.g., UCSD Science Map

- After you added the new plugins, load an ISI file using 'File > Load and Clean ISI File > EugeneGarfield.isi.'
  The file can be found in the */sampledata/scientometrics/isi* directory.
- Select '99 Unique ISI Records' file in Data Manger and run 'Visualization > Topical > Science Map via Journals' with parameters:

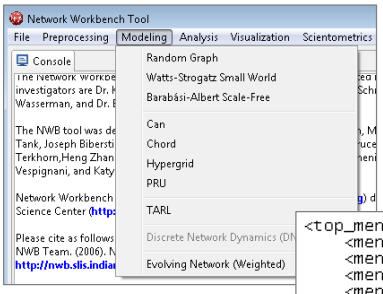


- The result is a science map overlay of Garfield's papers and a listing of journals in 13 fields of science below. See details in **Tutorial #6**.



CIShell – Customize Menu

- 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>
```


CIShell – Integrate New Algorithms

Algorithm Developer's Guide

Overview

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.

This guide attempts to aid algorithm developers in creating algorithms for CIShell (and applications built on CIShell).

This guide tries to contain all the information a new developer needs, but where necessary, it may cite the CIShell 1.0 Specification (API) or the OSGi Service Platform Specification, Release 4 (API). While the guide tries to make beginning algorithm development easier, the CIShell Specification has the last word on how the CIShell Platform works.

Table of Contents

http://cishell.org/?n=DevGuide.NewGuide

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OSGi/CIShell Adoption

CIShell/OSGi is at the core of different CIs and a total of 169 unique plugins are used in the
- ***Information Visualization*** (http://iv.slis.indiana.edu),
- ***Network Science (NWB Tool)*** (http://nwb.slis.indiana.edu),
- ***Scientometrics and Science Policy (Sci^2 Tool)*** (http://sci.slis.indiana.edu), and
- ***Epidemics*** (http://epic.slis.indiana.edu) research communities.

Most interestingly, 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.

The Changing Scientific Landscape

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

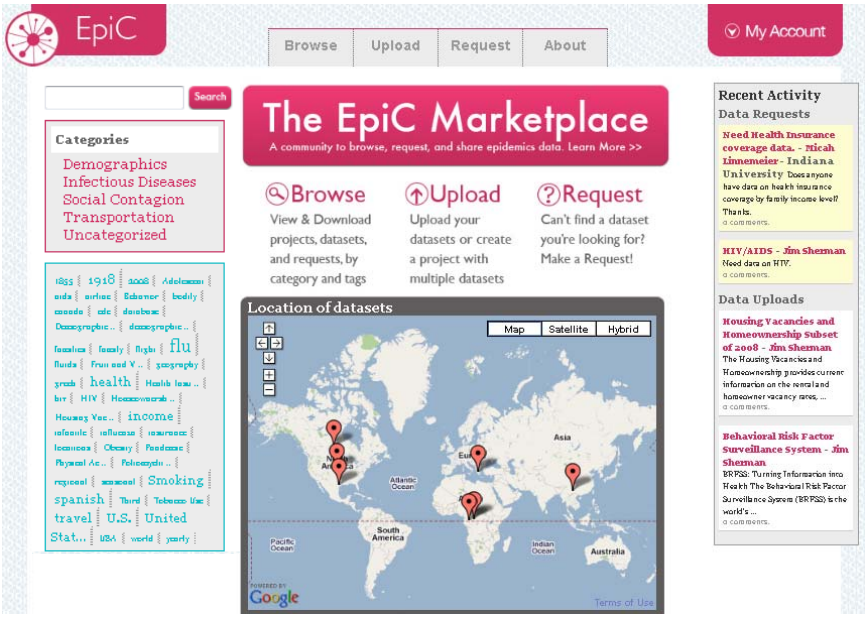
Scholarly Database: 23 million scholarly records
http://sdb.slis.indiana.edu

VIVO National Researcher Networking
http://vivoweb.org

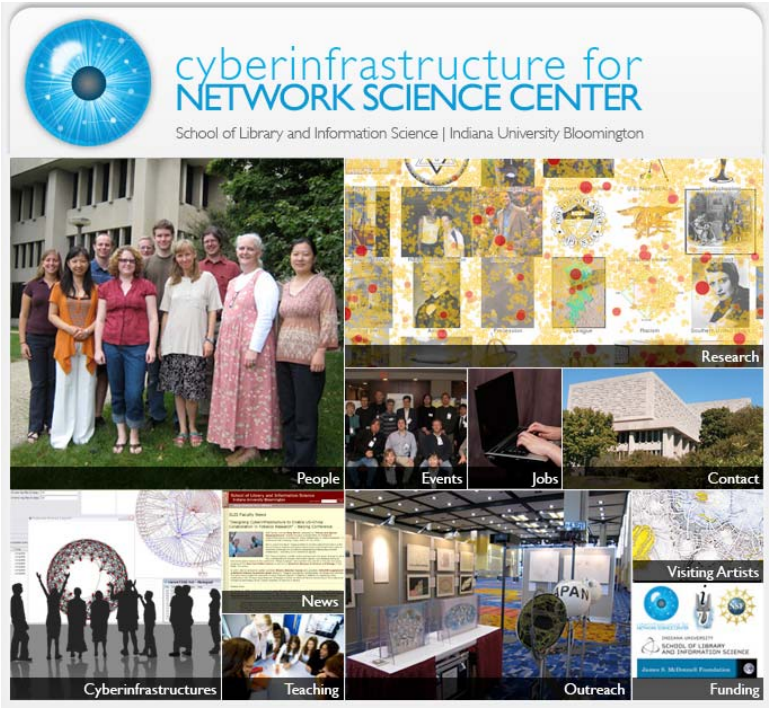
Static Instrument -> Evolving Cyberinfrastructure (CI) daily learning and documentation.

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!

Epidemics Marketplace



http://dev.epic.slis.indiana.edu



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