Plug and Play Macroscopes: Empowering Anyone To Convert Data Into Insights

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Director, Cyberinfrastructure for Network Science Center
School of Informatics and Computing and Indiana University Network Science Institute
Indiana University, USA

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University of Duisburg-Essen, Germany
December 21, 2016

The Power of Data Visualizations

Find your way

Find collaborators, friends

Identify trends

Terra bytes of data

Descriptive & Predictive Models
Mapping the Evolution of Co-Authorship Networks
Ke, Visvanath & Börner. 2004. Won 1st prize at the IEEE InfoVis Contest.
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.

Supported by NIH/NCI Contract HHSN261200800812
The Global 'Scientific Food Web'

**Contributions:**
Comprehensive global analysis of scholarly knowledge production and diffusion on the level of continents, countries, and cities.

Quantifying knowledge flows between 2000 and 2009, we identify global sources and sinks of knowledge production. Our knowledge flow index reveals, where ideas are born and consumed, thereby defining a global 'scientific food web'.

While Asia is quickly catching up in terms of publications and citation rates, we find that its dependence on knowledge consumption has further increased.
Places & Spaces: Mapping Science Exhibit
Places & Spaces: Mapping Science Exhibit, online at http://scimaps.org

Language Communities of Twitter - Eric Fischer - 2012
Places & Spaces at Northwestern University
May 14 - September 23, 2015

Places & Spaces Exhibit at the David J. Sencer CDC Museum, Atlanta, GA
January 25-June 17, 2016
Illuminated Diagram Display on display at the Smithsonian in DC.
http://scimaps.org/exhibit_info/#ID
Science Maps in “Expediti3on 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.expediti3on-zukund.de

Elinor Ostrom - Nobel Prize in Economic Sciences 2009
Basic 3 August 2009 in Thund, WA, USA
Affiliation at the time of the award: Indiana University Bloomington, IN, USA;
Office of Social Science, Temple, PA, USA.

Public statement: "For the analysis of economic governance, especially the commons."

Elinor Ostrom was a professor of political science and economics at Indiana University and a leader in the field of political economy. She was awarded the Nobel Prize in Economic Sciences in 2009 for her work on the governance of common resources. Her research focused on the design of institutions for natural resource management and the role of collective action in sustainable management.

About
This formative display with the facility of an interactive program to the incredible high data results of a site. This technique is generally useful when there is information that needs to be displayed on a screen but the data is too large to print. The computer can direct the eye by what is important and not only present data as a flat list, allowing the research targeted to individuals, job offers, a "social face" of science, of highlighting open results that are often not known. The screen, in use the background, will be used during the conference with an overlay of meaningful light.

Science Maps

Cancer  Closing HIV  Robert C. Edwards  Roger B. Kornberg  Elinor Ostrom

Quality of Life  Smoking  Stanley B. Prusiner  Ahmed H. Zewail

View All

Keyword Search

Science Maps in “Expediti3on 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.expediti3on-zukund.de
Places & Spaces Digital Display in North Carolina State’s brand new Immersion Theater

Ingo Gunther’s Worldprocessor globe design on display at the Giant Geo Cosmos OLED Display at the Museum of Emerging Science and Innovation in Tokyo, Japan
Plug-and-Play Macroscopes
Microscopes, Telescopes, Macroscopes

The Infinitely Great

Telescope
Stars

The Infinitely Small

Microscope
Cells

Different datasets/formats. Diverse algorithms/tools written in many programming languages.

Plug-and-Play Macroscopes

Different datasets/formats. Diverse algorithms/tools written in many programming languages.

Physics

IS

CS

Bio

SNA
Plug-and-Play Macroscopes

Developers

CIShell Wizards

Alg

Alg

Alg

Tool

Tool

Users

CIShell

Sci2 Tool

Workflow

Workflow

Workflow

Workflow

Common algorithm/tool pool

Easy way to share new algorithms

Workflow design logs

Custom tools

EpiC

Converters

Sci2

NWB

TexTrend

IS

CS

Bio

SNA

Phys
Information Visualization Framework & IVMOOC

Tasks

<table>
<thead>
<tr>
<th>LEVELS</th>
<th>MICRO: Individual Level about 2,000 records page 5</th>
<th>MESO: Local Level about 1,000–10,000 records page 9</th>
<th>MACRO: Global Level more than 100,000 records page 20</th>
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**TYPES**

- Multilevel Analysis page 43
- Temporal Analysis page 50
- Generational Analysis page 53
- Temporal Analysis page 50
- Network Analysis page 53

See page 5
**Visualization Framework**

### Data Scale Types
- nominal
- ordinal
- interval
- ratio

### Visualization Types
- table
- chart
- graph
- map
- network layout

### Graphic Symbol Types
- geometric symbols
- point
- line
- area
- surface
- volume
- linguistic symbols
- text
- numerals
- punctuation marks
- pictorial symbols
- icons
- images
- statistical glyphs

### Graphic Variable Types
- spatial position
- relational form
- color
- optics
- motion

### Interaction Types
- overview
- zoom
- search and locate
- filter
- details-on-demand
- history
- extract
- link and brush
- projection
- distortion

---

**Basic Task Types**

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<td>compare and contrast</td>
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<td>process and time</td>
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<td>trend</td>
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<td>spatial relations</td>
<td>location</td>
<td>generate maps</td>
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<td>correlations/relationships</td>
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See page 24
Visualization Framework

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<th>Insight Need Types</th>
<th>Data Scale Types</th>
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<th>Graphic Symbol Types</th>
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<td>- category/cluster</td>
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<td>- ratio</td>
<td>- map</td>
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See page 24

Graphic Variable Types Versus Graphic Symbol Types

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<th>Position</th>
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<th>Value</th>
<th>Shape</th>
<th>Rotation</th>
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Course Schedule

Part 1: Theory and Hands-On
- **Session 1** – Workflow Design and Visualization Framework
- **Session 2** – “When:” Temporal Data
- **Session 3** – “Where:” Geospatial Data
- **Session 4** – “What:” Topical Data

Mid-Term
- **Session 5** – “With Whom:” Trees
- **Session 6** – “With Whom:” Networks
- **Session 7** – Dynamic Visualizations and Deployment

Final Exam

Part 2: Students work in teams on client projects.

Final grade is based on Class Participation (10%), Midterm (30%), Final Exam (30%), and Client Project (30%).

Needs-Driven Workflow Design
Needs-Driven Workflow Design

**Stakeholders**

**Validation**
**Interpretation**

**Read**
**Analyze**

**Data**

**Types and levels of analysis** determine data, algorithms & parameters, and deployment

Load **One** File and Run **Many** Analyses and Visualizations

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<thead>
<tr>
<th>Times Cited</th>
<th>Publication Year</th>
<th>City of Publisher</th>
<th>Country</th>
<th>Journal Title (Full)</th>
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**Statistical Analysis** - p. 44
**Temporal Behavior Analysis** - p. 48
**Geospatial Analysis** - p. 52

Citations:
- Netherlands: 53, 292
- United States: 9, 318
- Germany: 11, 36
- United Kingdom: 14, 1
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Co-author and many other bi-modal networks.

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All papers, maps, tools, talks, press are linked from http://cns.iu.edu
These slides are at http://cns.iu.edu/docs/presentations

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