CNS Cyberinfrastructure for Network Science Center

THOMSON REUTERS

JOIN US: AAAS LUNCHEON DISCUSSION

VISUALIZATION METAPHORS FOR COMMUNICATING THE STRUCTURE AND DYNAMICS OF SCIENCE

JULIA LAURIN, THOMSON REUTERS AND KATY BÖRNER, INDIANA UNIVERSITY

Please join us and take part in our lunchtime discussion titled "Visualization Metaphors for Communicating the Structure and Dynamics of Science" hosted by Julia Laurin, Thomson Reuters and Katy Börner, Indiana University.

Date: Sunday, February 15, 2015

Time: 12 PM to 1 PM (PST)

Location: San Jose Convention Center
AAAS Conference Room: Glen Ellen
150 West San Carlos Street
San Jose, CA 95113

This luncheon will provide an opportunity for those who produce and work with maps of science to discuss the challenges of visualizing non-spatial scientific activity and investigate concrete ways for scholars and industry to advance understanding and engagement with maps of science. Brief talks by leading experts and brainstorming will be used to identify: What visual metaphors have been successful for representing trends, emerging research areas, or bursts of activity, etc.? Are there best practices for representing non-spatial information? How can the different teams producing maps of science collectively enhance the legibility and utility of science maps?

Agenda

Welcome by Julia and Katy

Setting the Stage:
Visual Languages: Industry Pull
by Julia Laurin, Thomson Reuters
Visualization Frameworks: Academic Push
by Katy Börner, Indiana University

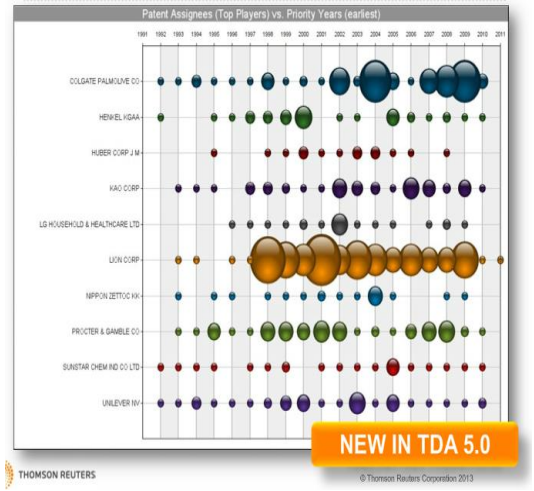
Invited Talk:
Visualizing Knowledge Spaces: Cartographic Perspectives
by Dr. André Skupin, Geography, San Diego State University

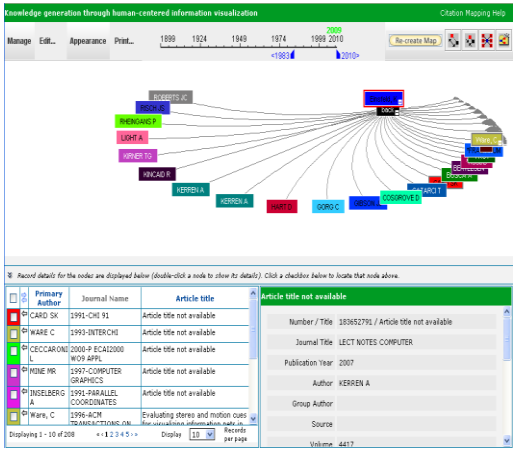
Discussion

Visual Languages: Industry Pull

by Julia Laurin, Thomson Reuters

Visualizing Across Domains: Lessons Learned





Intellectual Property

Thomson Data Analyzer

- **Support multiple approaches to data**

Life Sciences

Cortellis Data Fusion

- **User-driven and use case driven**

Scholarly Research

Web of Science

- **Balancing transparency and usability**

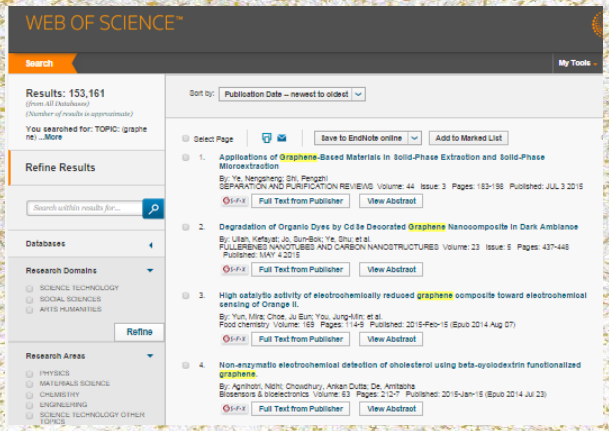
Graph Analytics: Answering the Big Questions

Mission: *Research and develop solutions which support graph data, analytics and machine learning at big data scales*

How do we provide research funders with **areas of research on the verge of developing** into new fields and worthy of deeper funding?	graph community detection and prediction
How do we provide scientific researchers with a **topic hierarchy for research discovery which remains current** w/rt recently published articles?	graph-based topic generation and clustering
How do we provide university administrators with **aggregation tools that effectively disambiguate entities** like people and organizations?	graph-based pattern matching

Getting from Table to Graph

37,225,696 publications
602,346,147 total citations

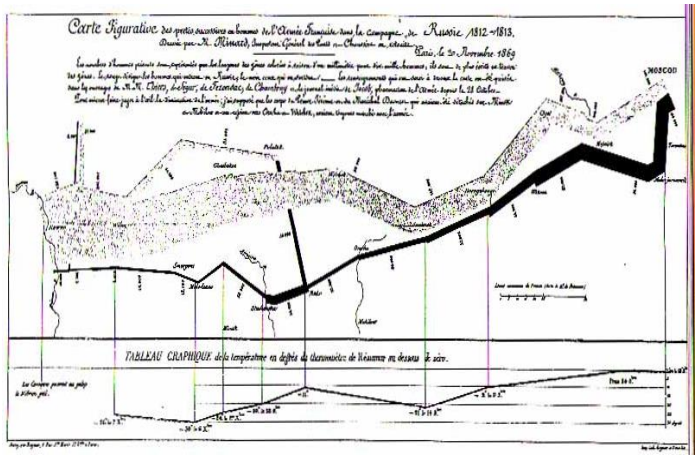


Mapping Science Requires *a lot* of Choices

- Insight needed
- Types of analysis
- Levels of analysis
- Data scale types
- Visualization types
- Graphic symbol types
- Level of interactivity

Uncharted Territory – Together

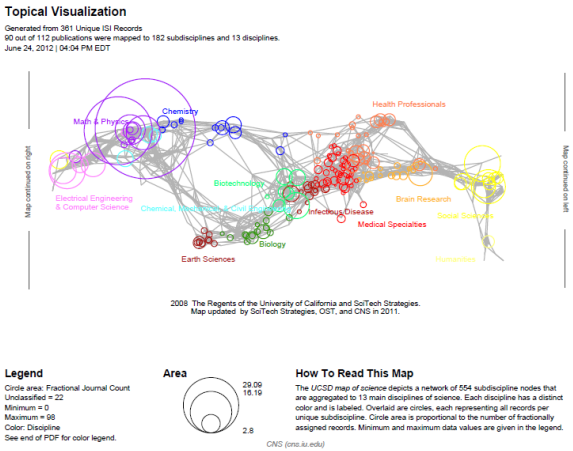
- Visual perception and cognition
- Power of big computing
- Sheer complexity of data
- Interactive and 3D gamification

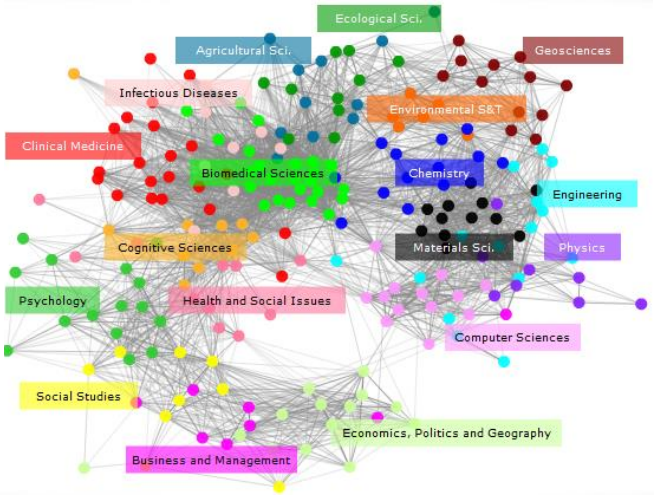


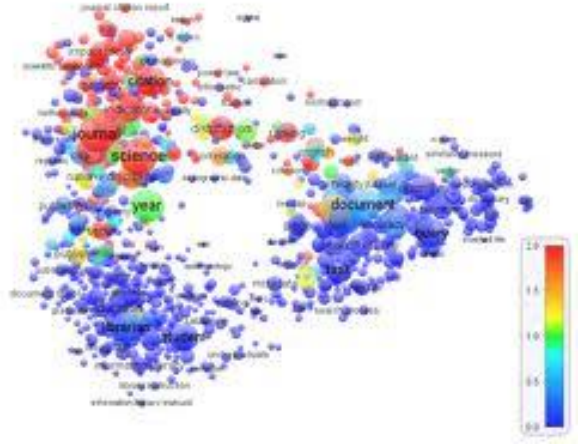
Visualization Frameworks: Academic Push

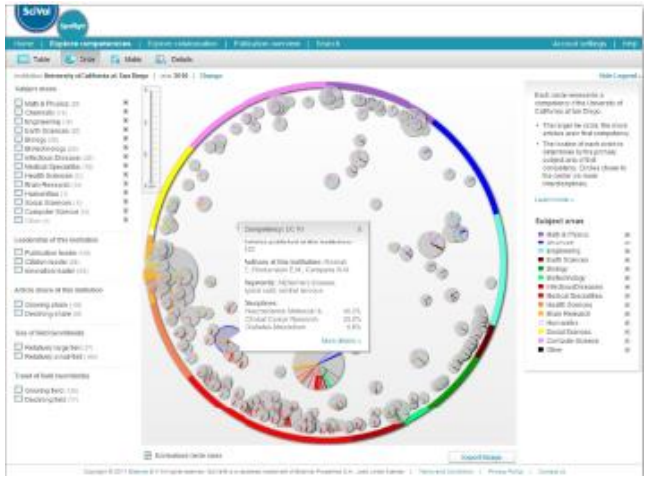
by Katy Börner, Indiana University

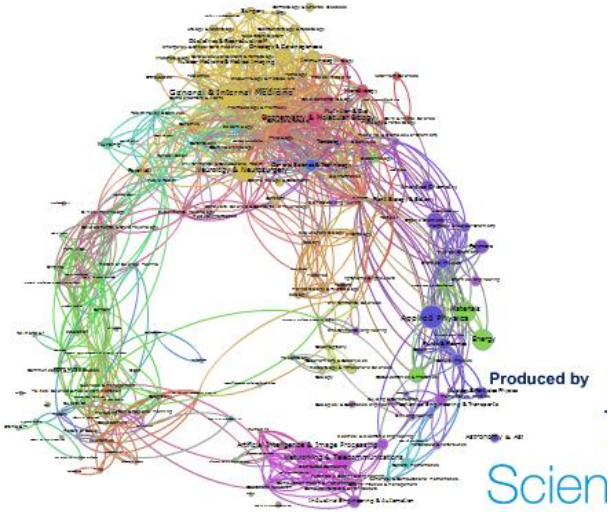
De-Facto Standardization of Science Basemaps

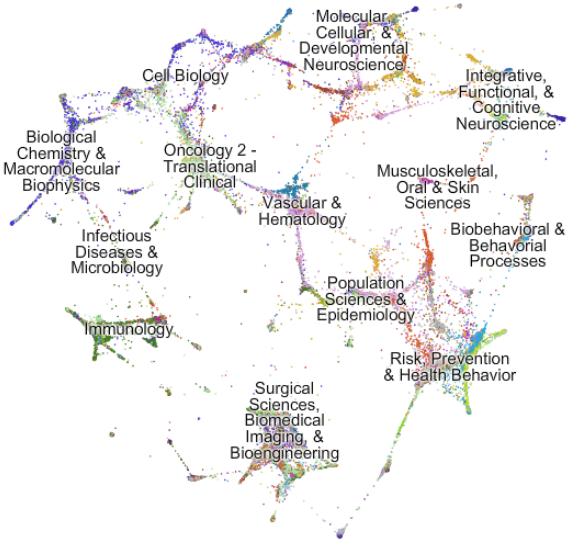













NANOTECHNOLOGY
Human Connecto

How to Classify Different Visualizations?

By

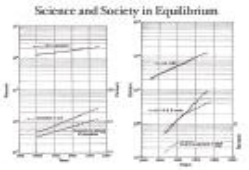
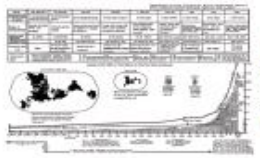
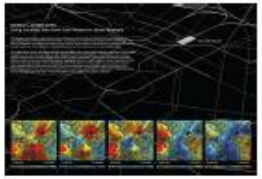
- User insight needs?
- User task types?

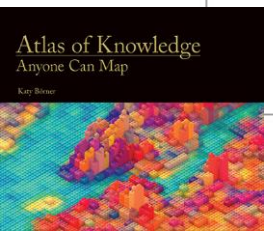
- Data to be visualized?
- Data transformation?

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

How to support the design of effective visualizations by experts and citizen scientists?

Study

TYPES	LEVELS MICRO: Individual Level about 1–1,000 records page 6	MESO: Local Level about 1,001–100,000 records page 8	MACRO: Global Level more than 100,000 records page 10
Statistical Analysis page 44	 Knowledge Cartography page 135	 Productivity of Russian life sciences research teams page 105	 Number of scientists versus population and R&D costs versus GNP. page 103
WHEN: Temporal Analysis page 48	 Visualizing decision-making processes page 95	 Key events in the development of the video tape recorder page 85	 Increased travel and communication speeds page 83
WHERE: Geospatial Analysis page 52	 Cell phone usage in Milan, Italy page 109	 Victorian poetry in Europe page 137	 Ecological footprint of countries page 99
WHAT: Topical Analysis page 56	 Evolving patent holdings of Apple Computer, Inc. and Jerome Lemelson page 89	 Evolving journal networks in nanotechnology page 139	 Product space showing co-export patterns of countries page 93
WITH WHOM: Network Analysis page 60	 World Finance Corporation network page 87	 Electronic and new media art networks page 133	 World-wide scholarly collaboration networks page 157



See page 5

Workflow Design

Interpret

Validation and Interpretation, **page 72**

Acquire

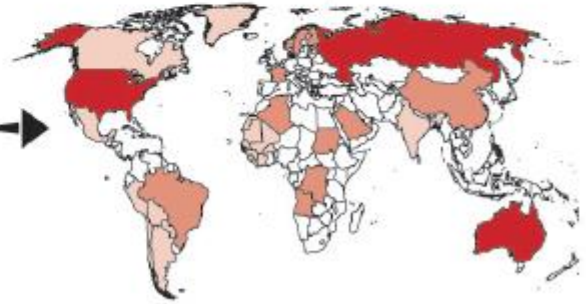
User Needs Acquisition, **page 40**
Data Acquisition, **page 42**

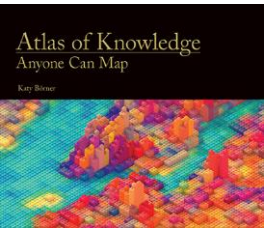
Deploy

Human-Computer Interface, **page 70**
Interaction, **page 68**
Combination, **page 66**

Analyze & Visualize

Statistical Studies, **page 44**
Statistical Visualization Types, **page 46**
Temporal Studies—"When", **page 48**
Temporal Visualization Types, **page 50**
Geospatial Studies—"Where", **page 52**
Geospatial Visualization Types, **page 54**
Topical Studies—"What", **page 56**
Topical Visualization Types, **page 58**
Network Studies—"With Whom", **page 60**
Network Visualization Types, **page 62**
Studying Dynamics, **page 64**



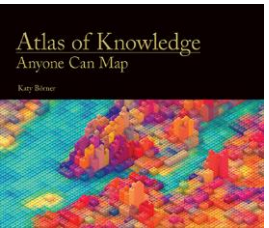


See page 24

Types

relevant for the design of effective visualizations

Insight Need Types page 26	Data Scale Types page 28	Visualization Types page 30	Graphic Symbol Types page 32	Graphic Variable Types page 34	Interaction Types page 26
• categorize/cluster • order/rank/sort • distributions (also outliers, gaps) • comparisons • trends (process and time) • geospatial • compositions (also of text) • correlations/relationships	• nominal • ordinal • interval • ratio	• table • chart • graph • map • network layout	• geometric symbols point line area surface volume • linguistic symbols text numerals punctuation marks • pictorial symbols images icons statistical glyphs	• spatial position • retinal form color optics motion	• overview • zoom • search and locate • filter • details-on-demand • history • extract • link and brush • projection • distortion



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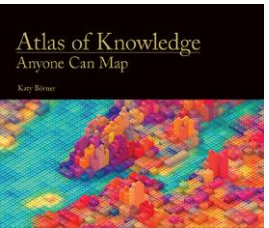
Basic Task Types								
Bertin, 1967	Wehrend & Lewis, 1996	Few, 2004	Yau, 2011	Rendgen & Wiedemann, 2012	Frankel, 2012	Tool: Many Eyes	Tool: Chart Chooser	Börner, 2014
selection	categorize			category				categorize/ cluster
order	rank	ranking					table	order/rank/ sort
	distribution	distribution					distribution	distributions (also outliers, gaps)
	compare	nominal comparison & deviation	differences		compare and contrast	compare data values	comparison	comparisons
		time series	patterns over time	time	process and time	track rises and falls over time	trend	trends (process and time)
		geospatial	spatial relations	location		generate maps		geospatial
quantity		part-to-whole	proportions		form and structure	see parts of whole, analyze text	composition	compositions (also of text)
association	correlate	correlation	relationships	hierarchy		relations between data points	relationship	correlations/ relationships



See page 26

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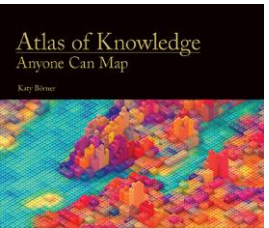

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Visualization Types (Reference Systems)

1. **Charts:** No reference system—e.g., Wordle.com, pie charts

2. **Tables:** Categorical axes that can be selected, reordered; cells can be color coded and might contain proportional symbols. Special kind of graph.

3. **Graphs:** Quantitative or qualitative (categorical) axes. Timelines, bar graphs, scatter plots.

4. **Geospatial maps:** Use latitude and longitude reference system. World or city maps.

5. **Network graphs:** Node position might depends on node attributes or node similarity. **Tree graphs:** hierarchies, taxonomies, genealogies. **Networks:** social networks, migration flows.

Types

relevant for the design of effective visualizations

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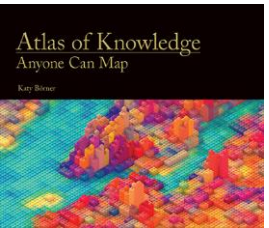

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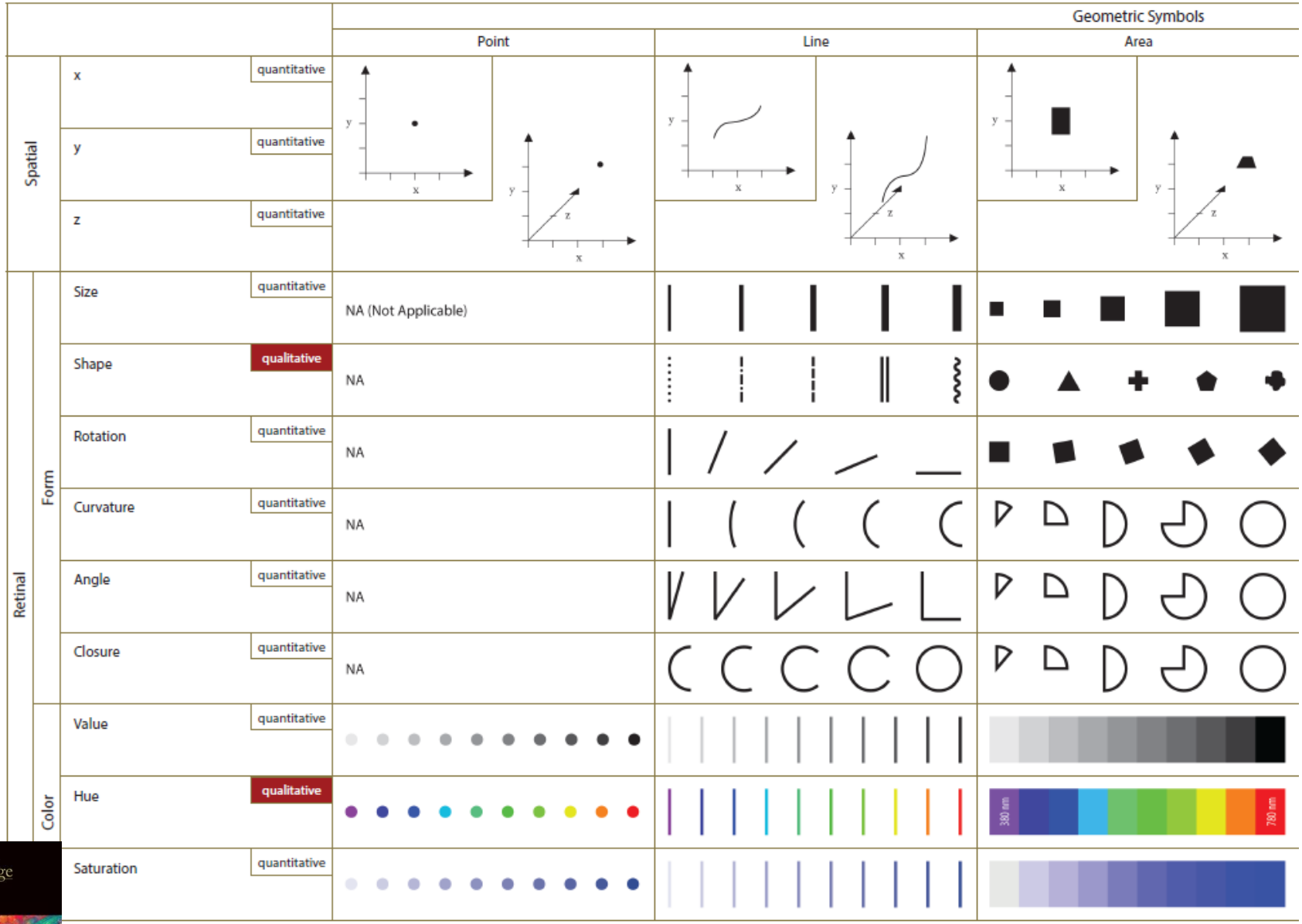
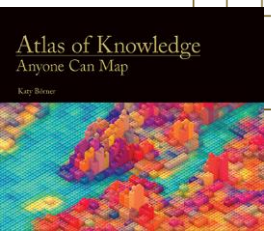
Graphic Variable Types Versus Graphic Symbol Types





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Atlas of Knowledge: Anyone Can Map

« back to the store

by Katy Börner
To be published by MIT Press on March 13, 2015
Pre-Order Now

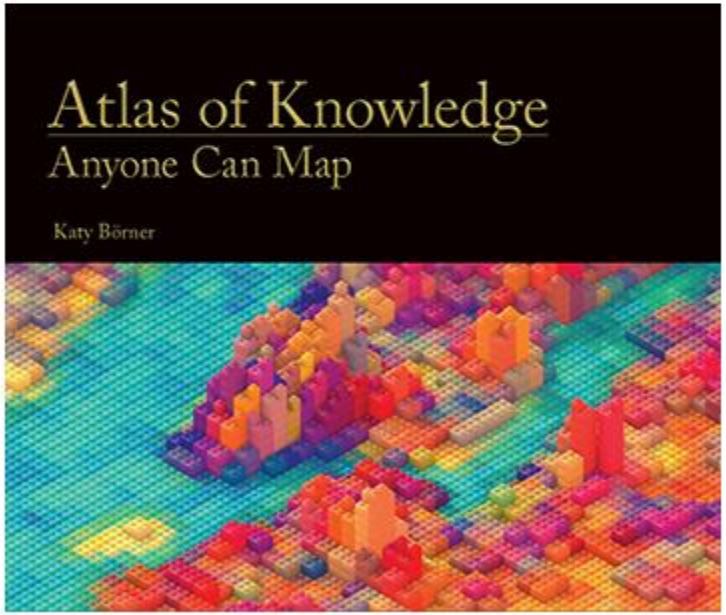
13 x 11, 250 pp.
580 illus.
978-0-262-02881-3
Download informational flyer

Introduction | Author | Awards | History | Vendors | Images | References | Q&A | Press

Introduction

In an age of information overload, the ability to make sense of vast amounts of data and to render insightful visualizations is as important as the ability to read and write. The *Atlas of Knowledge* explains and exemplifies the power of visualizations not only to help locate us in physical space but also to help us understand the extent and structure of our collective knowledge, to identify bursts of activity, pathways of ideas, and borders that beg to be crossed.

Drawing on 15 years of research and tool development, the *Atlas* introduces a theoretical visualization framework meant to empower anyone to systematically render data into insights. It aims to teach "timeless" knowledge that



http://scimaps.org/atlas2

Information Visualization MOOC 2015

INDIANA UNIVERSITY CNS

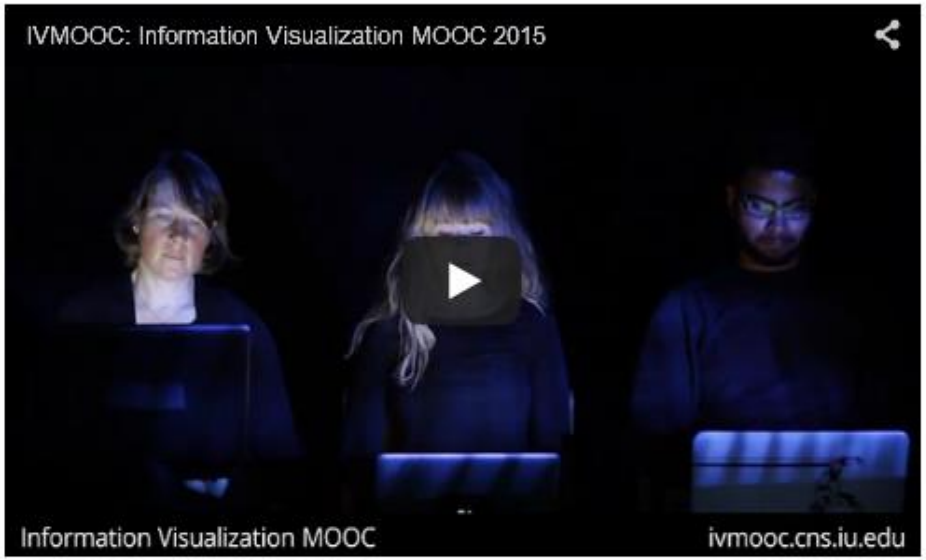
Overview

This course provides an overview about the state of the art in information visualization. It teaches the process of producing effective visualizations that take the needs of users into account.

The course can be taken for three Indiana University credits as part of the Online Data Science Program, as part of the Information and Library Science M.S. program, and as part of the online Data Science M.S. Program offered by the School of Informatics and Computing. Students seeking enrollment information should contact Rhonda Spencer at 812-855-2018, ilsmain@indiana.edu or datasci@indiana.edu.

Among other topics, the course covers:

- Data analysis algorithms that enable extraction of patterns and trends in data
- Major temporal, geospatial, topical, and network visualization techniques
- Discussions of systems that drive research and development.



Register for Course

Already registered? Click here to go to the course.
Forgot your password? Click here to reset it.

http://ivmooc.cns.iu.edu

Invited Talk:

Visualizing Knowledge Spaces: Cartographic Perspectives

by Dr. André Skupin, Geography, San Diego State University

André Skupin

Professor of Geography
San Diego State University

Founder & Co-Director
Center for Information Convergence and Strategy
San Diego State University

Associate Director
Center for Entrepreneurship and Innovation
University of Dubai

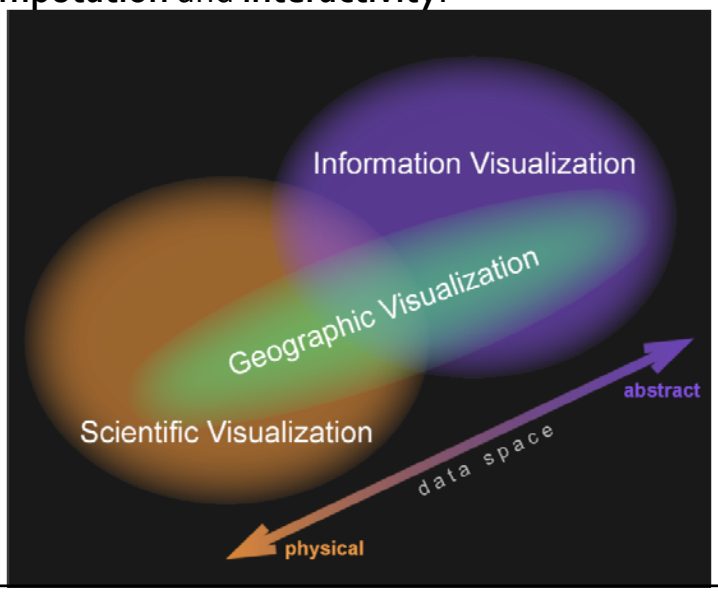
Co-Founder & Co-CEO
BigKnowledge LLC

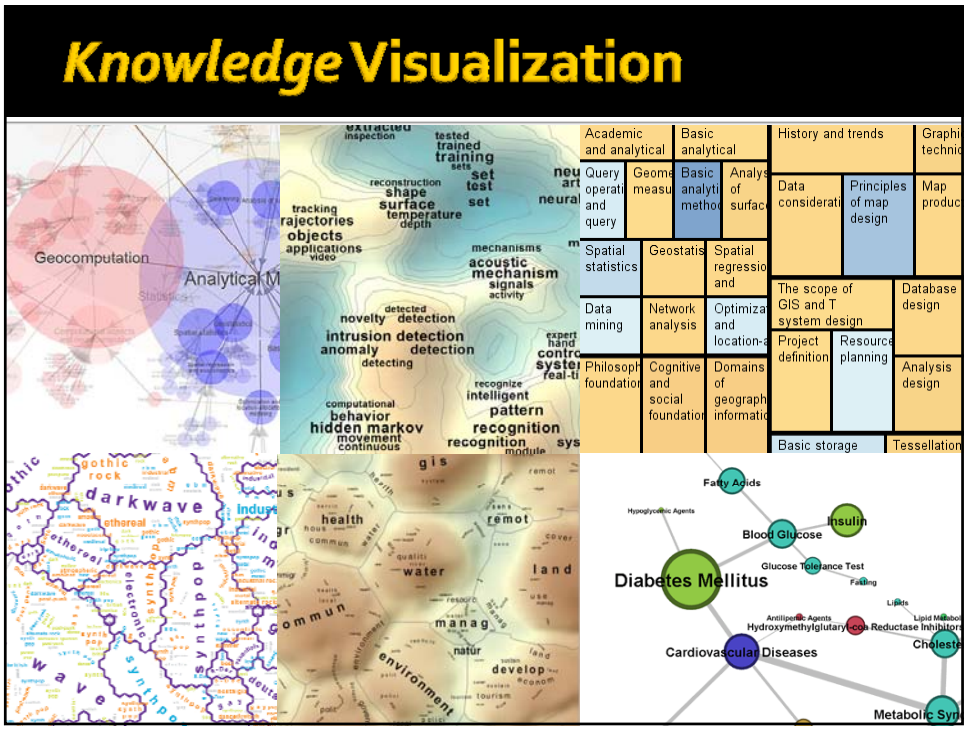
Visualizing Knowledge Spaces
Cartographic Perspectives

Visualizing Knowledge Spaces
Cartographic Perspectives

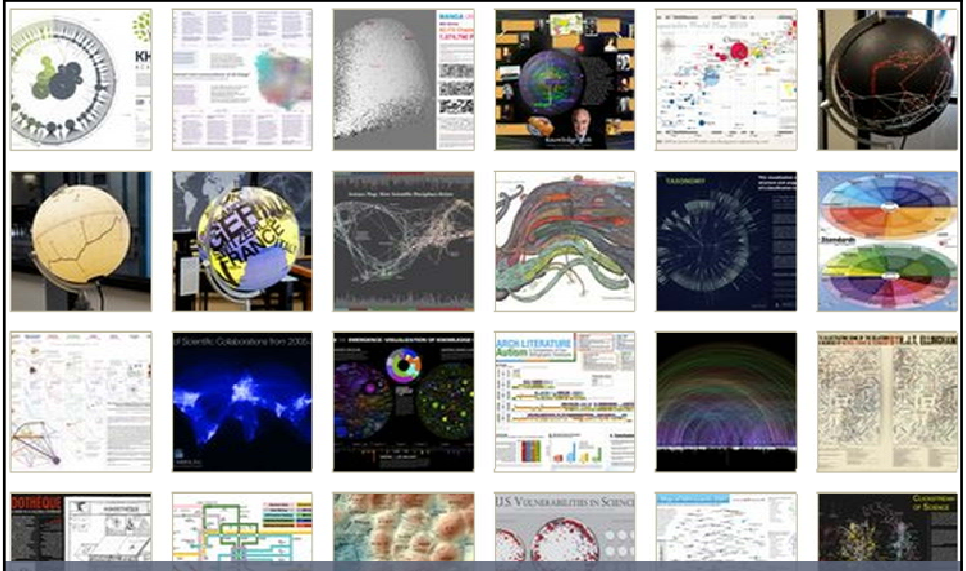
- What is Visualization?
- Cartographic Lesson I: "Space – The Final Frontier"
- Cartographic Lesson II: "It's all been done before!"
- The Power of Spatial Concepts
- Gallery of Base Maps
- Visualization for Impact: Partners, Cultures, Values

"Visualization is a **data-driven representation** aimed at **amplifying cognition,** frequently supported by **computation** and **interactivity**."





Knowledge Visualization



See: http://scimaps.org/

Spaces of Visualization

- **Geographic Space**
  - Discrete objects
  - Continuous fields
- **Vector Space**
  - Entities
  - Properties
- **Network Space**
  - Nodes
  - Links
- **Knowledge Space**
  - Domains
  - Actors
  - Concepts
  - Artifacts

It's all been done before

- Data → Symbols → Understanding
- Scale & Abstraction
- Semantic Zooming
- Base Map Creation
- Base Map Use
- Thematic Overlays
- Truth in Mapping

Data → Symbols → Understanding

visual | *graphic* | *semiotic* variables

- for static maps
  - Bertin (1967/1983)
    - seven variables
      - *Position*
      - Size
      - Value
      - Texture
      - Hue
      - Orientation
      - Shape

Data → Symbols → Understanding

visual | *graphic* | *semiotic* variables

- for static maps
  - Bertin+
    - eight variables
      - size
      - value
      - saturation
      - pattern texture
      - pattern arrangement
      - hue
      - orientation
      - shape

Data → Symbols → Understanding

visual | *graphic* | *semiotic* variables

- for static maps
  - Bertin+
    - quantitative data
      - size
      - value
      - saturation
      - pattern texture
    - qualitative data
      - pattern arrangement
      - hue
      - orientation
      - shape

Data → Symbols → Understanding

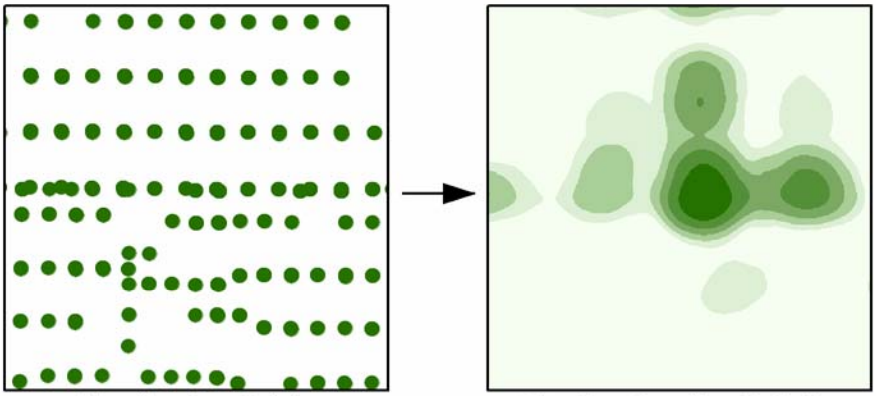
visual | *graphic* | *semiotic* variables

- for static maps
  - Bertin+
    - quantitative data
      - size
      - value
      - saturation
      - pattern texture
    - qualitative data
      - pattern arrangement
      - hue
      - orientation
      - shape
- for animated maps
  - duration
  - rate of change
  - order
  - display date
  - frequency
  - synchronization

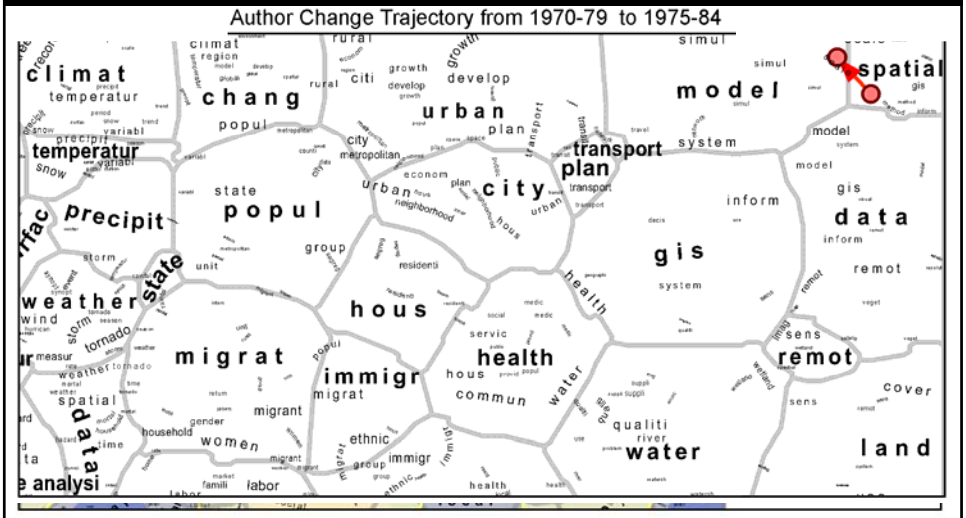
Scale & Abstraction

From: Zondervan (1901) *Allgemeine Karten kunde*, Leipzig: B. G. Teubner. (Original source: *Sydow-Wagners Methodischer Schulatlas)*

From Raw Data to Relevant Insight

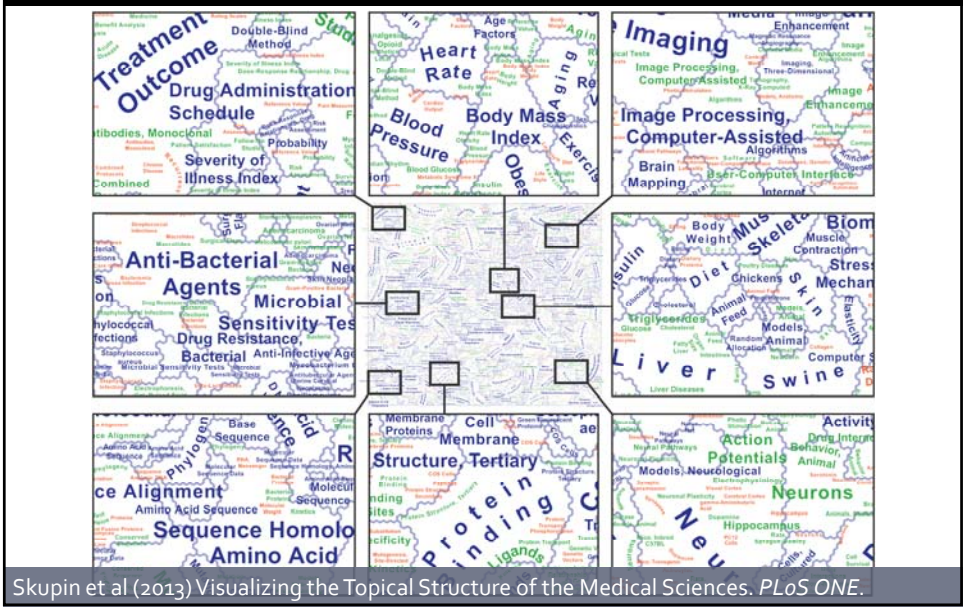


Power of Concepts: Author as *Discrete Object*

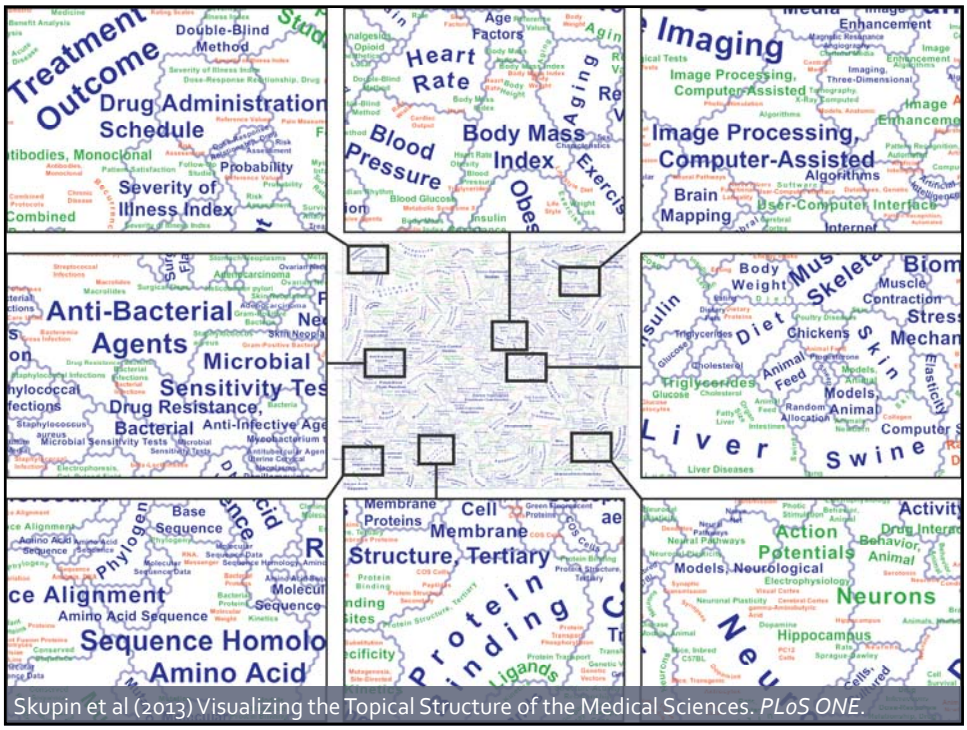


Skupin, A. (2009) Discrete and Continuous Conceptualizations of Science: Implications for Knowledge Domain Visualization. *Journal of Informetrics*.

Base map: Two million biomedical papers



Skupin et al (2013) Visualizing the Topical Structure of the Medical Sciences. *PLoS ONE*.



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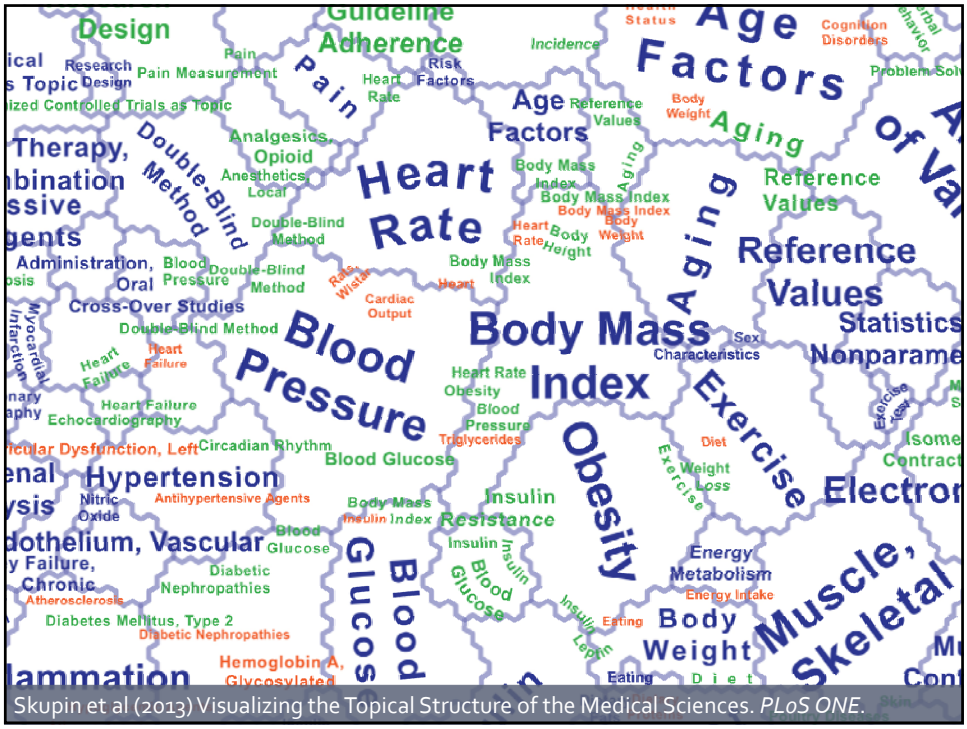

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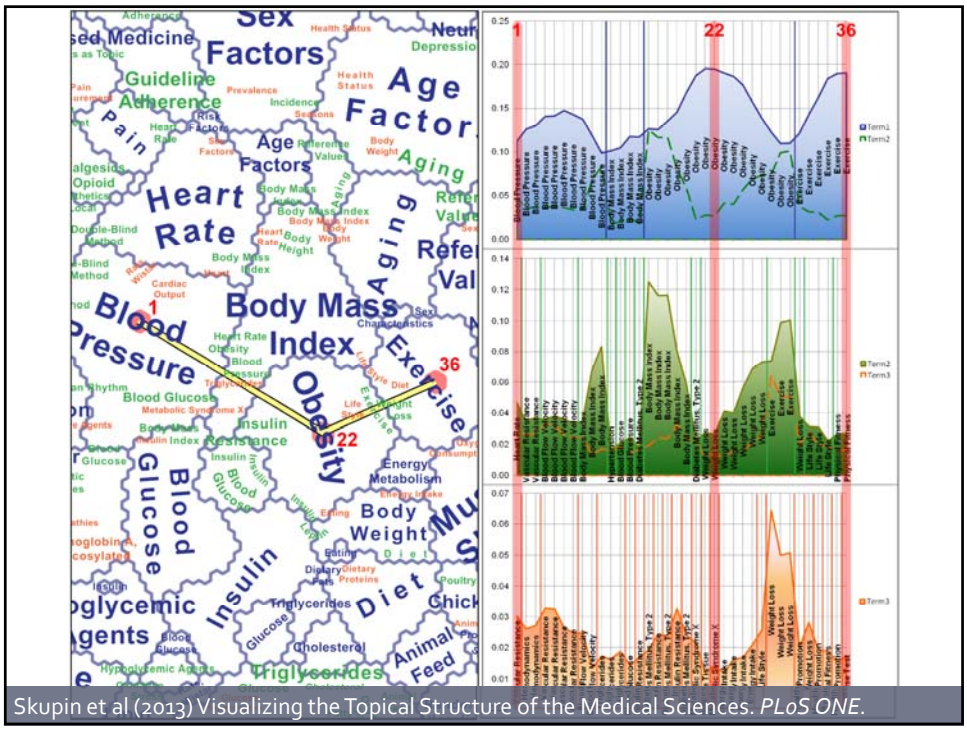
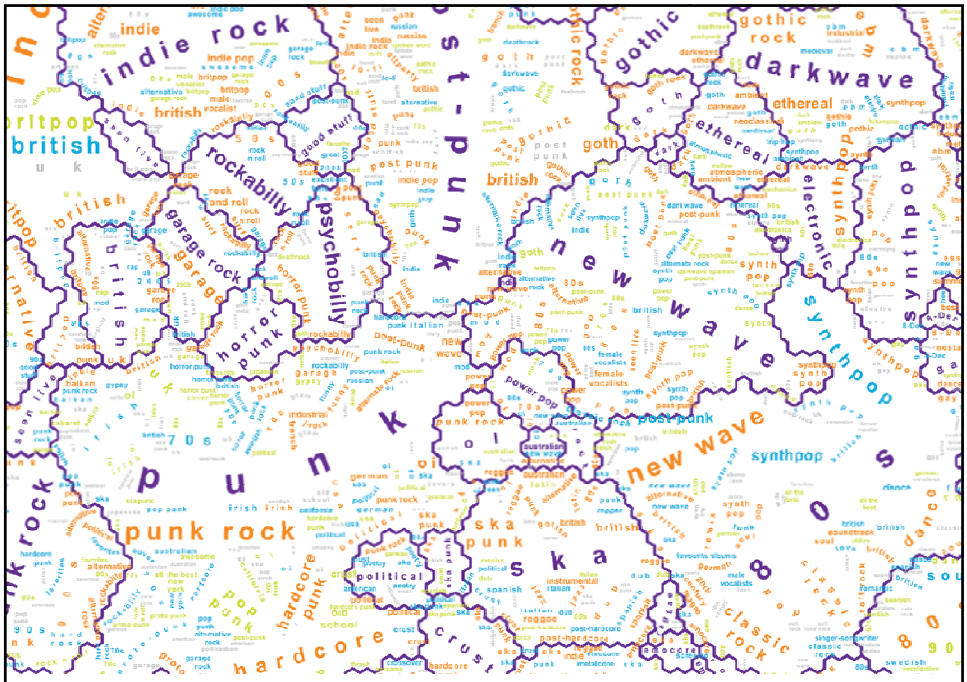


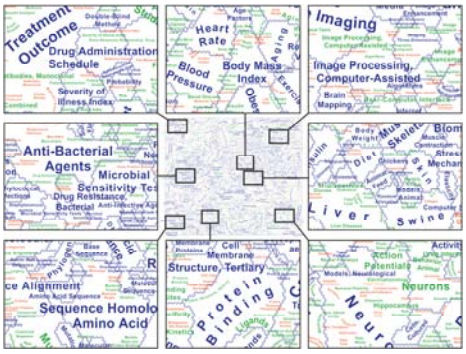
Skupin et al (2013) Visualizing the Topical Structure of the Medical Sciences. *PLoS ONE*.

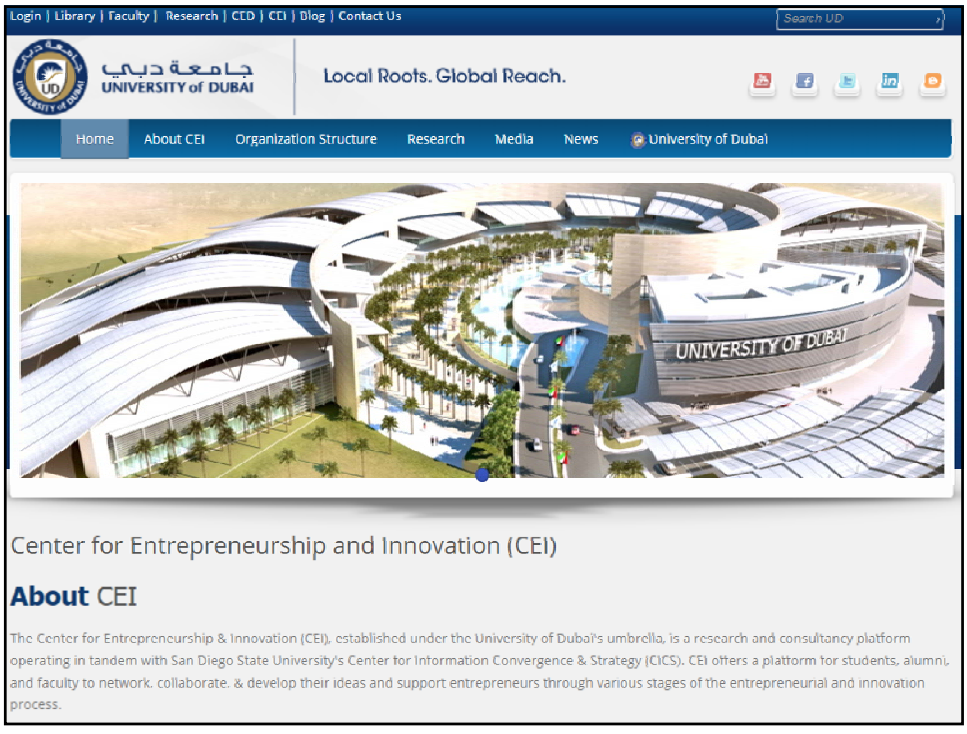


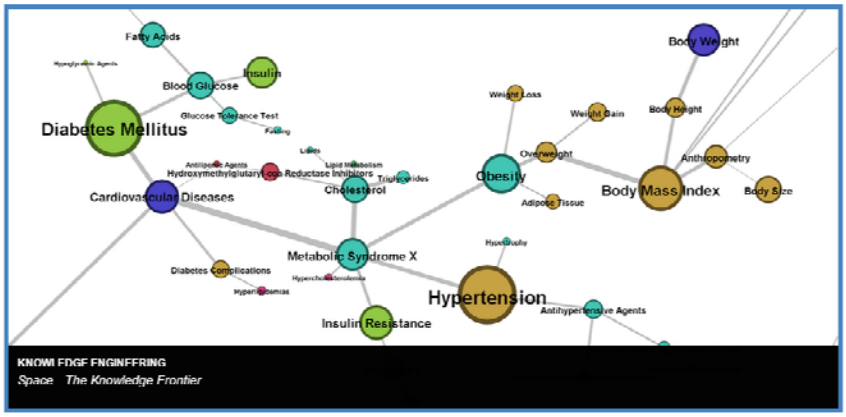
2010 NSF/Science Visualization Challenge: Finalist
2011 International Institute for Information Design Award (Social Affairs Category)

Visualization for Impact:
Partners, Cultures, Values

- Impactful Visualization
  - **I**nspire [domain experts]
  - **C**onnect [across disciplines]
  - **U**nderstand [domain patterns]
- Power of Diversity
  - Partners
  - Institutions
  - Disciplines
  - Cultures
  - Technologies
  - Values







BigKnowledge focuses on domain specific knowledge management and analytics solutions. We enable domain communities to discover, manage, and operationalize the knowledge hidden among very diverse data, ranging from formal ontologies to large collections of text content, geodata, and multivariate databases. The domains in which we operate include higher education, healthcare, biomedicine, law, and finance.

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Set your organization's knowledge free, with ontology-driven solutions for capturing, organizing, and operationalizing domain knowledge. more...

Knowledge Analytics

Advanced computational and visual solutions for turning large document collections into novel products, engaging and interactive more...

Knowledge Engineering

Uniquely multi-spatial approaches for leveraging the knowledge hidden in multivariate data, network data, and geodata in support of domain understanding and decision-support. more...