

Macrosopes

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Indiana University Network Science Institute
Indiana University, USA

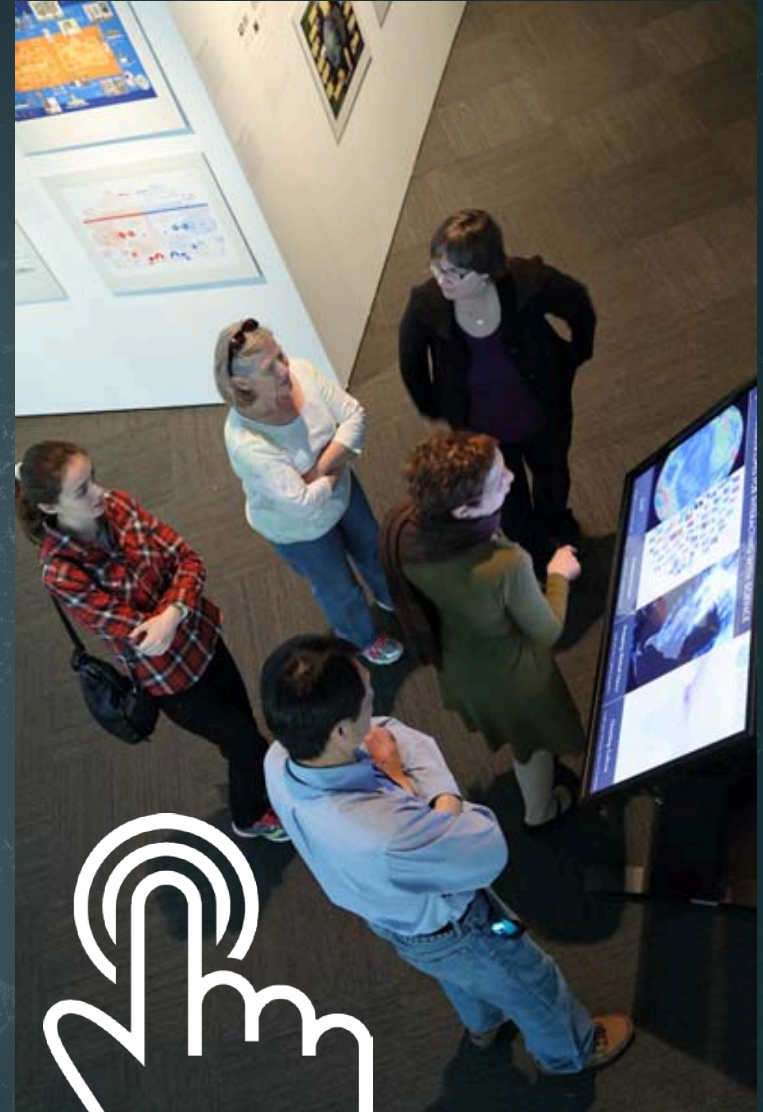
IUB Data Science Club
IQ Wall Room in Library East, Indiana University, Bloomington
Wednesday, April 12, 2017



In Terms of Geography - Andre Skupin - 2005

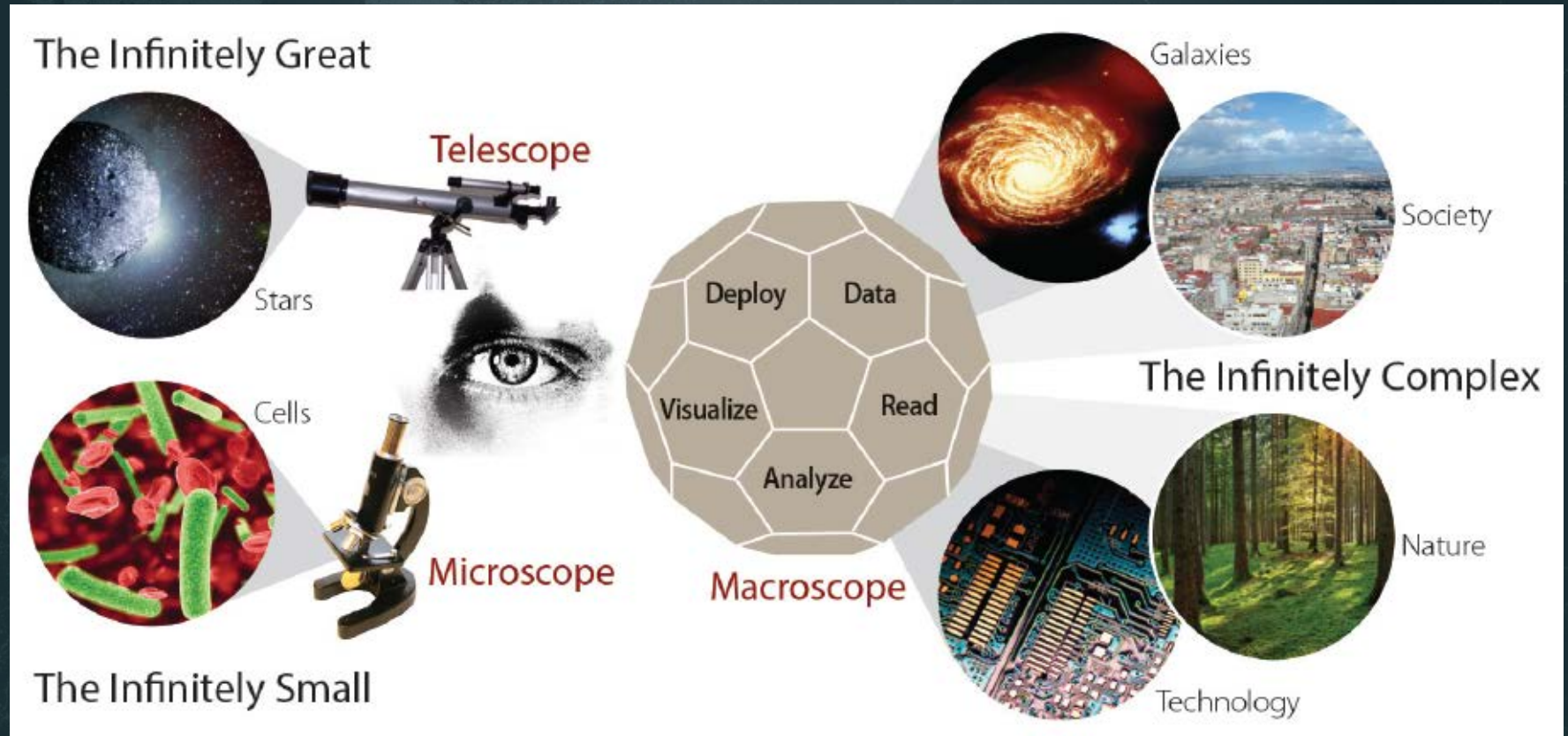


MAPS vs. MACROSCOPES

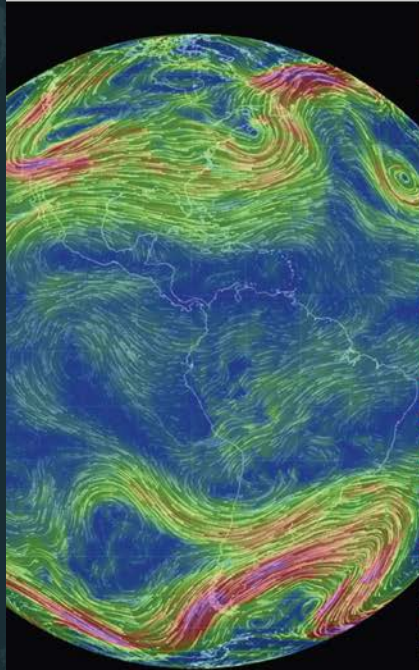


<http://web.avl.indiana.edu/~pdbeard/macroscope-kiosk/dist/#/>

Microscopes & Telescopes vs. MACROSCOPES



i MACROSCOPES FOR INTERACTING WITH SCIENCE



Earth

Weather on a worldwide scale



AcademyScope

Exploring the scientific landscape



Mapping Global Society

Local news from a global perspective

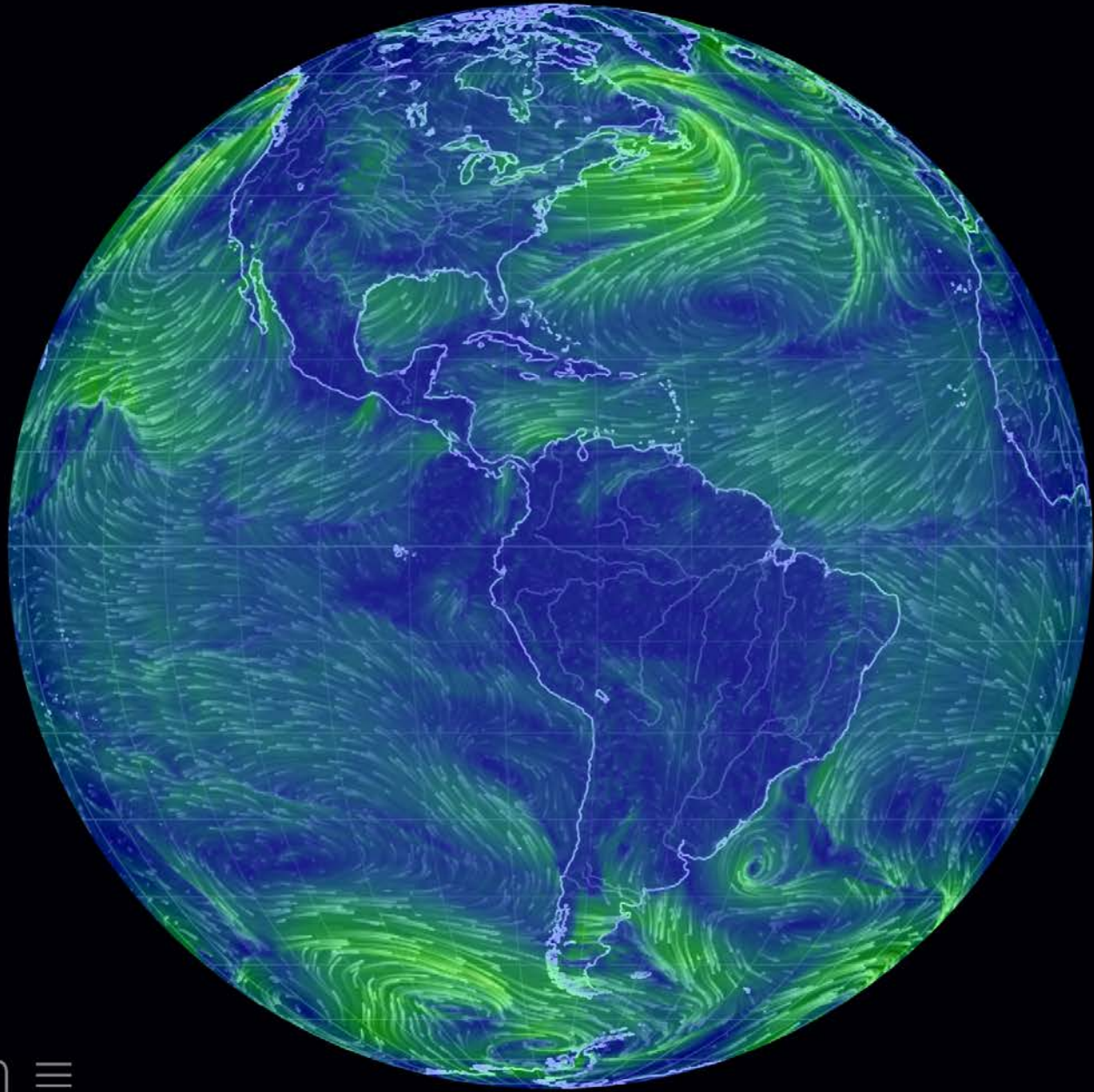


Charting Culture

2,600 years of human history in 5 minutes

Iteration XI (2015): Macroscopes for Interacting with Science

<http://scimaps.org/iteration/11>



earth ≡

Earth – Cameron Beccario

Top downloads



- Agriculture
- Behavioral and Social Sciences
- Biography and Autobiography
- Biology and Life Sciences
- Computers and Information Technology
- Conflict and Security Issues
- Earth Sciences
- Education
- Energy and Energy Conservation
- Engineering and Technology
- Environment and Environmental Studies
- Explore Science
- Food and Nutrition
- Health and Medicine
- Industry and Labor
- Math, Chemistry and Physics
- Policy for Science and Technology
- Space and Aeronautics
- Transportation

opic=282

The News Co-occurrence Globe

An interactive visualization of how countries are mentioned together in the world's news media

+ - UNITED KINGDOM SEARCH ABOUT



2.92K
COOCCUR%

UNITED KINGDOM cooccurrences in: 2,922%
cooccurrences out: 80%

Timeline: Feb 22, Mar 1, Mar 8, Mar 15, Mar 22, Mar 29, Apr 5, Apr 12, Apr 19, Apr 26, May 3, May 10, May 17, May 24



COOCCUR

IN%

OUT%



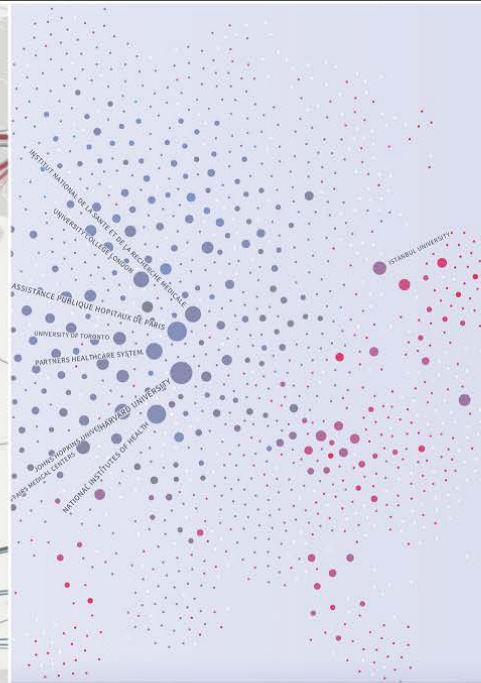
Smelly Maps

Charting urban smellscapes



HathiTrust

Storehouse of knowledge



Excellence Networks

Publish or perish together

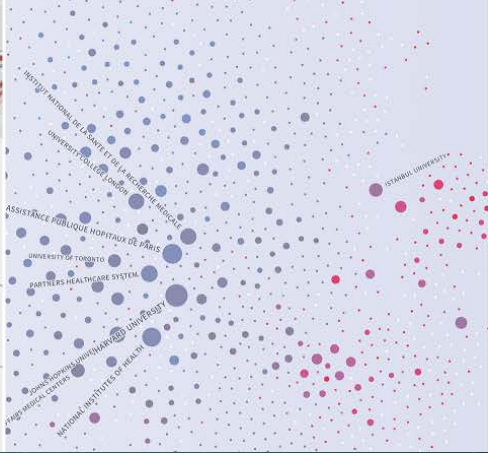


FleetMon Explorer

Tracking the seven seas

Iteration XII (2016): Macrosopes for Making Sense of Science

<http://scimaps.org/iteration/12>



Four new macrosopes debut at Vanderbilt University:

1. **Smelly Maps:** Features a “smellscape” of 12 cities mapped by smell using social media
2. **HathiTrust:** Highlights the diversity of publications collected in digital form by HathiTrust.
3. **Excellence Networks:** Compares how research institutions, such as Indiana and Vanderbilt universities, collaborate with one another.
4. **FleetMon:** Shows how the amount of shipping traffic that navigates the Strait of Malacca compared to other major shipping lanes of the world.

<http://scimaps.org/vanderbilt>



A visitor explores the macroscope kiosk at the Eskenazi Museum of Art at Indiana University.

Call for Macroscope Tools for the *Places & Spaces: Mapping Science* Exhibit (2017) <http://scimaps.org/call>

Background and Goals

The *Places & Spaces: Mapping Science* exhibit is designed to open people's hearts and minds to the value, complexity, and beauty of maps of science and technology.

Drawing from across cultures and across scholarly disciplines, the *Places & Spaces: Mapping Science* exhibit demonstrates the

IVMOOC.cns.iu.edu



PLACES
SPACES &
MAPPING SCIENCE

scimaps.org



Register for free: <http://ivmooc.cns.iu.edu>. Class started Jan 10, 2017.

Tasks

LEVELS

MICRO: Individual Level
about 1–1,000 records
page 6



MESO: Local Level
about 1,001–100,000 records
page 8

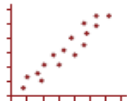


MACRO: Global Level
more than 100,000 records
page 10



TYPES

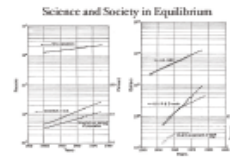
Statistical Analysis
page 44



Knowledge
Cartography
page 135



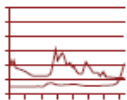
Productivity
of Russian
life sciences
research
teams
page 105



Science and Society in Equilibrium

Number
of scientists
versus
population
and R&D costs
versus GNP.
page 103

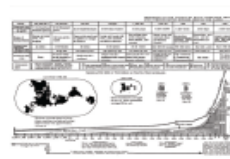
**WHEN:
Temporal Analysis**
page 48



Visualizing
decision-
making
processes
page 95

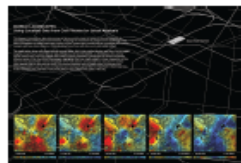


Key events
in the
development
of the video
tape recorder
page 85

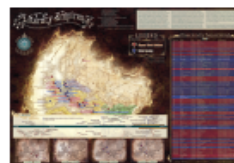


Increased
travel and
communication
speeds
page 83

**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



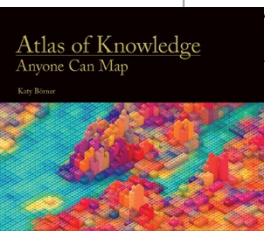
World
Finance
Corporation
network
page 87



Electronic and
new media art
networks
page 133

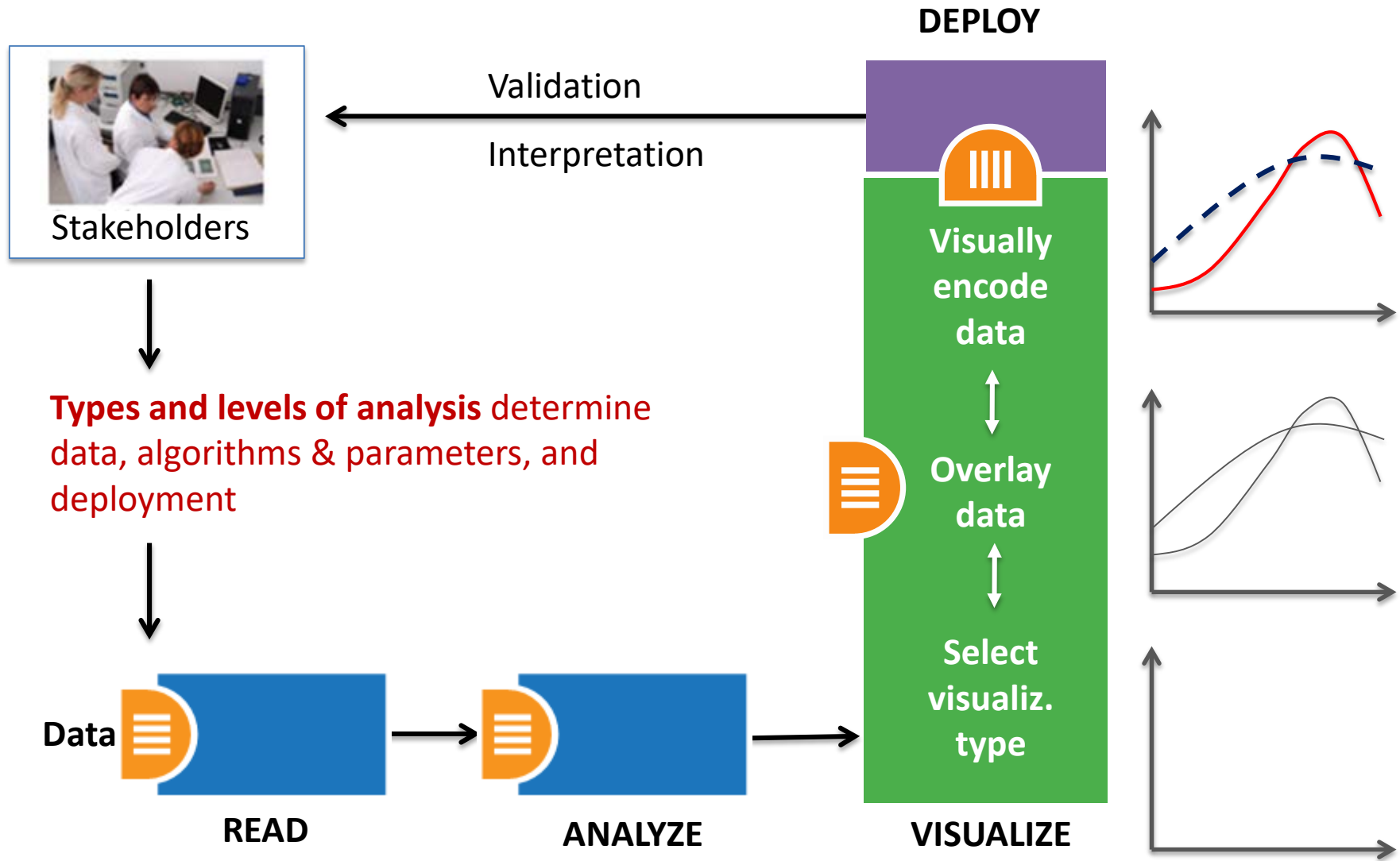


World-wide
scholarly
collaboration
networks
page 157

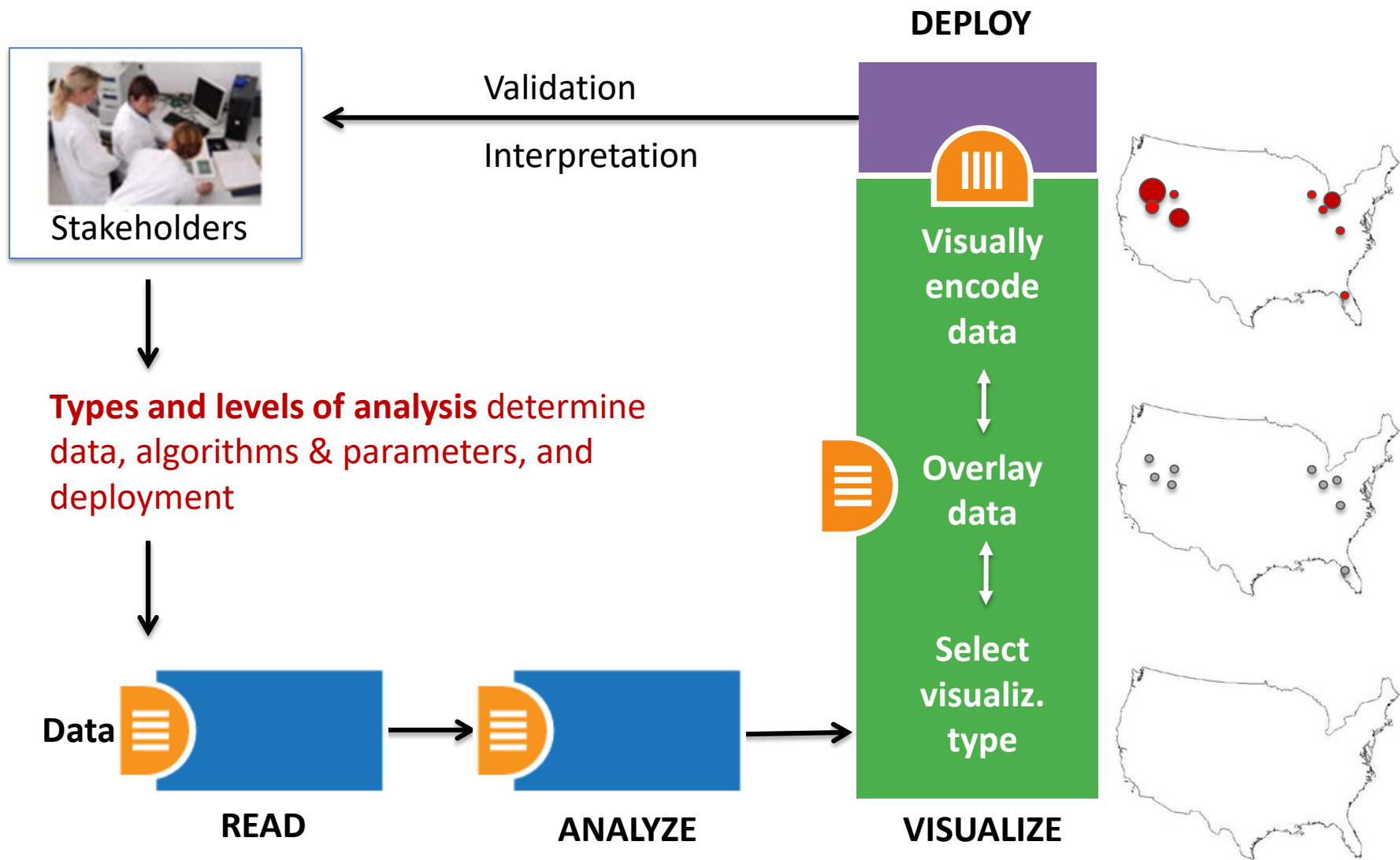


See page 5

Needs-Driven Workflow Design



Needs-Driven Workflow Design



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

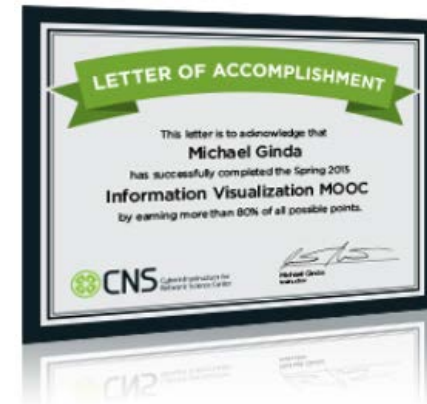
Mid-Term

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

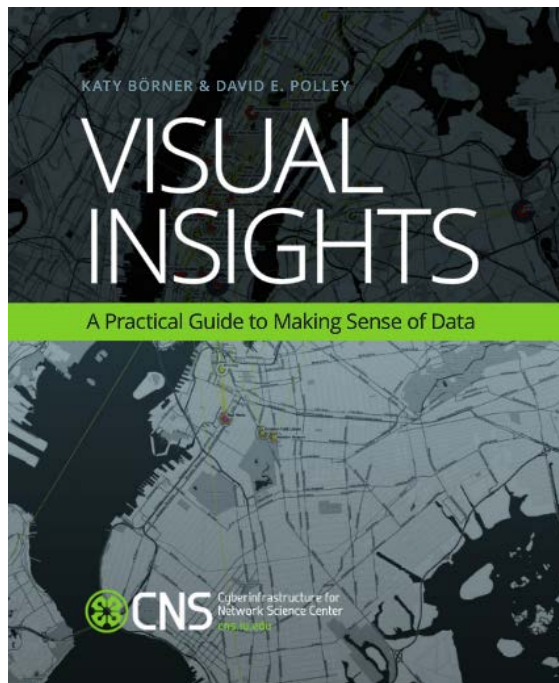
Final Exam

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%).

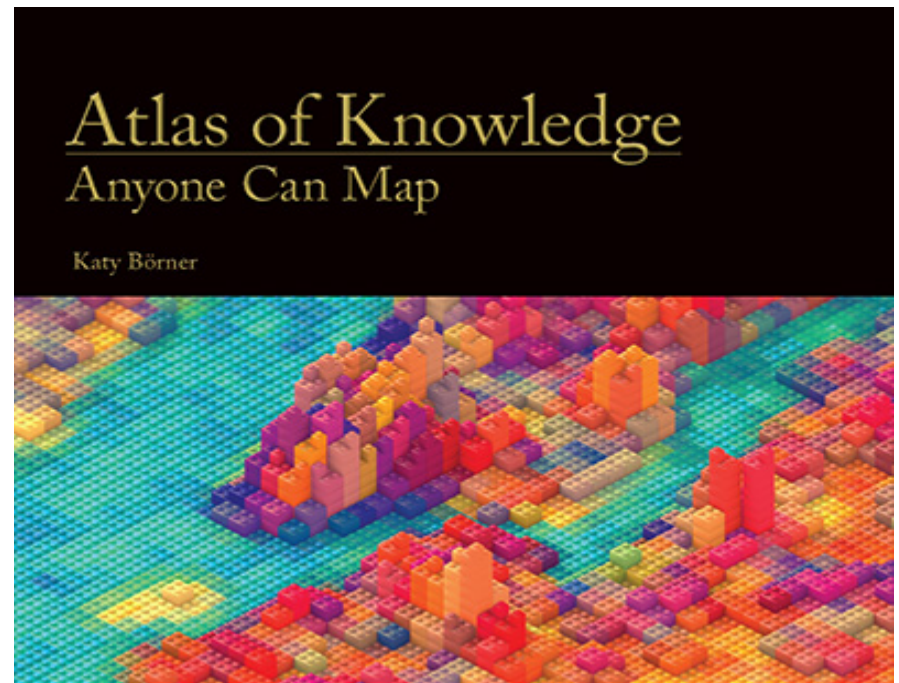


Books Used in the IVMOOC



Teaches timely knowledge:

Advanced algorithms, tools, and hands-on workflows.



Teaches timeless knowledge:

Visualization framework—exemplified using generic visualization examples and pioneering visualizations.

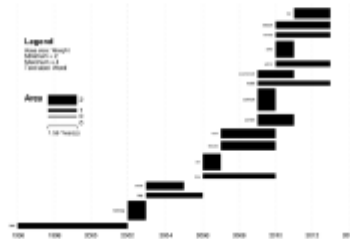
Load **One** File and Run **Many** Analyses and Visualizations

Times Cited	Publication Year	City of Publisher	Country	Journal Title (Full)	Title	Subject Category	Authors
12	2011	NEW YORK	USA	COMMUNICATIONS OF THE ACM	Plug-and-Play Microscopes	Computer Science	Borner, K
18	2010	MALDEN	USA	CTS-CLINICAL AND TRANSLATIONAL SCIENCE	Advancing the Science of Team Science	Research & Experimental Medicine	Falk-Krzesinski, HJ Borner, K Contractor, N Fiore, SM Hall, KL Keyton, J Spring, B Stokols, D Trochim, W Uzzi, B
13	2010	WASHINGTON	USA	SCIENCE TRANSLATIONAL MEDICINE	A Multi-Level Systems Perspective for the Science of Team Science	Cell Biology Research & Experimental Medicine	Borner, K Contractor, N Falk-Krzesinski, HJ Fiore, SM Hall, KL Keyton, J Spring, B Stokols, D Trochim, W Uzzi, B

Statistical Analysis—p. 44

Location	Count	# Citations
Netherlands	13	292
United States	9	318
Germany	11	36
United Kingdom	1	2

Temporal Burst Analysis—p. 48



Geospatial Analysis—p. 52



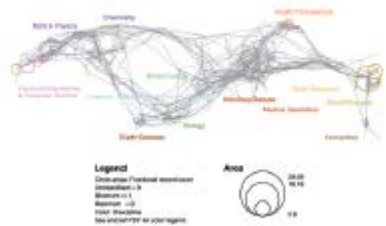
Geospatial Analysis—p. 52



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

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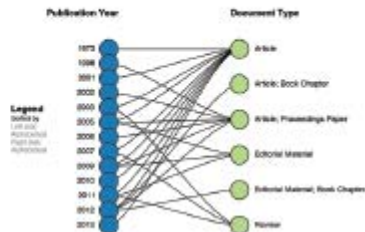
Topical Analysis—p. 56



Paper Citation Network—p. 60



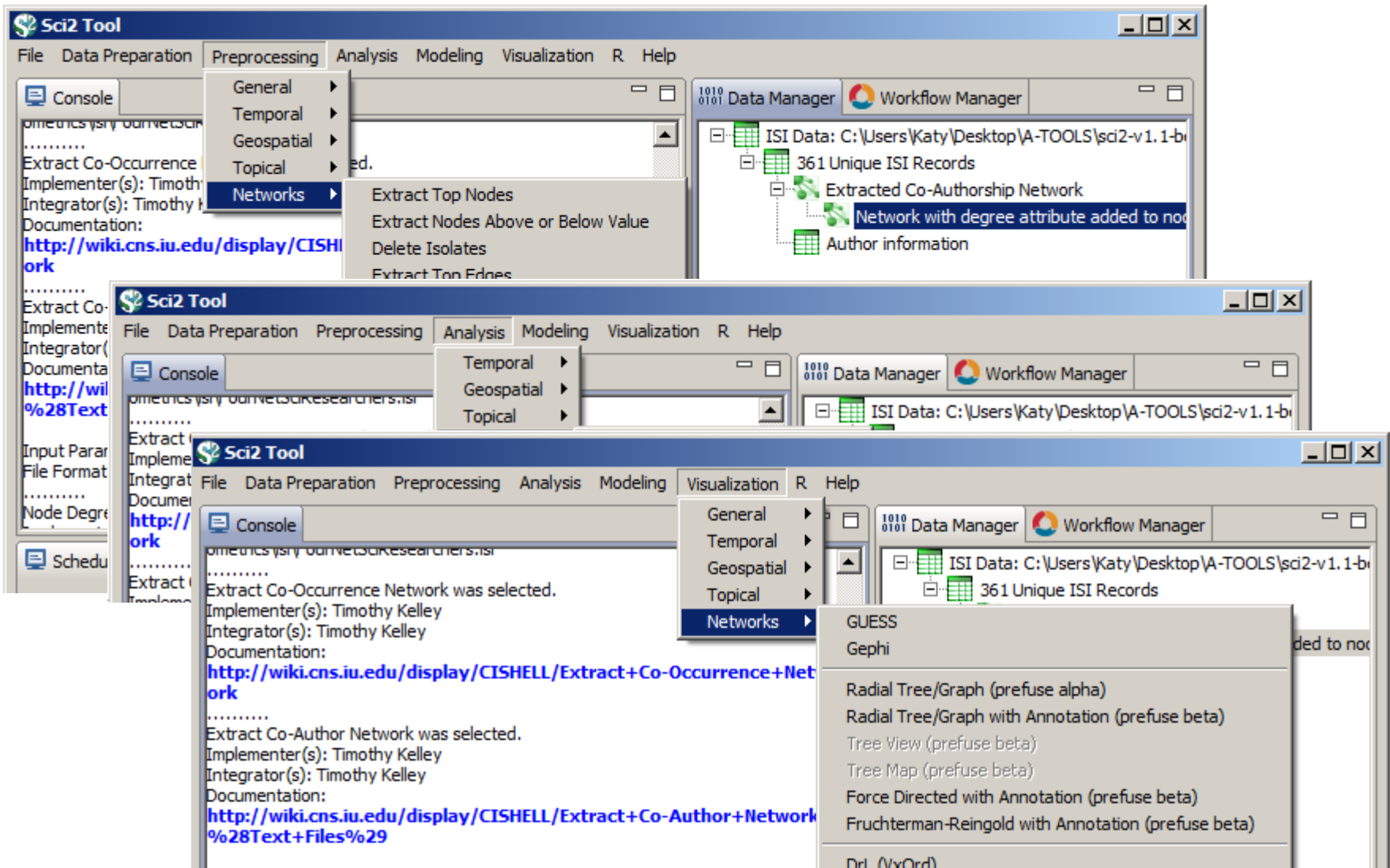
Bi-Modal Network—p. 60



Co-author and many other bi-modal networks.

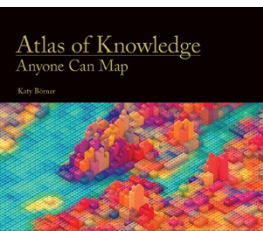
Sci2 Tool Interface Components

Download tool for free at <http://sci2.cns.iu.edu>



Visualization Framework

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
<ul style="list-style-type: none">• categorize/cluster• order/rank/sort• distributions (also outliers, gaps)• comparisons• trends (process and time)• geospatial• compositions (also of text)• correlations/relationships	<ul style="list-style-type: none">• nominal• ordinal• interval• ratio	<ul style="list-style-type: none">• table• chart• graph• map• network layout	<ul style="list-style-type: none">• geometric symbols<ul style="list-style-type: none">pointlineareasurfacevolume• linguistic symbols<ul style="list-style-type: none">textnumeralspunctuation marks• pictorial symbols<ul style="list-style-type: none">imagesiconsstatistical glyphs	<ul style="list-style-type: none">• spatial<ul style="list-style-type: none">position• retinal<ul style="list-style-type: none">formcoloropticsmotion	<ul style="list-style-type: none">• overview• zoom• search and locate• filter• details-on-demand• history• extract• link and brush• projection• distortion



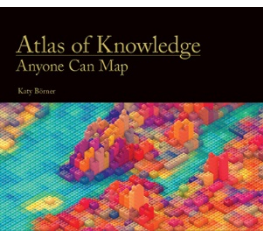
See page 24

Visualization Framework

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

Visualization Framework

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
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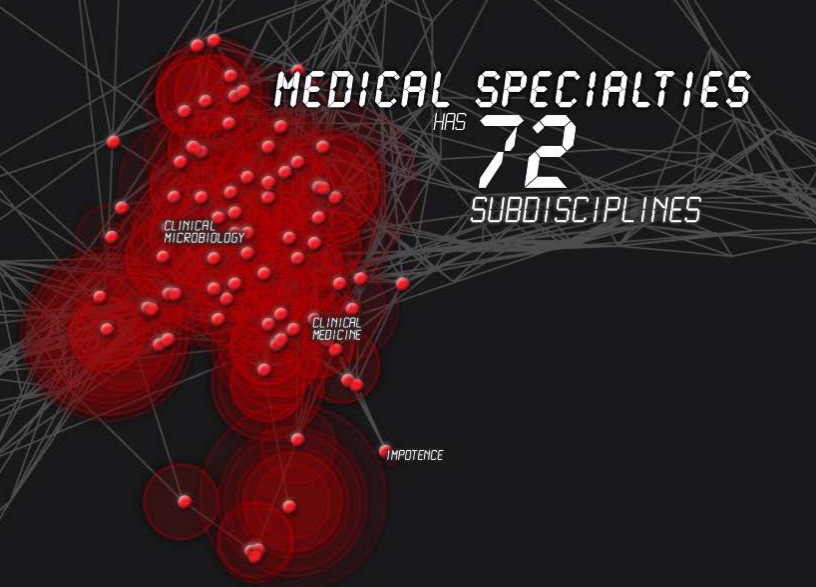
See page 24

Graphic Variable Types Versus Graphic Symbol Types

			Geometric Symbols					
			Point		Line		Area	
Spatial	x	quantitative						
	y	quantitative						
	z	quantitative						
Retinal	Form	Size	quantitative	NA (Not Applicable)				
		Shape	qualitative	NA				
		Rotation	quantitative	NA				
		Curvature	quantitative	NA				
		Angle	quantitative	NA				
		Closure	quantitative	NA				
	Color	Value	quantitative					
		Hue	qualitative					
		Saturation	quantitative					

Graphic Variable Types Versus Graphic Symbol Types

		Geometric Symbols					Linguistic Symbols Text, Numerals, Punctuation Marks		Pictorial Symbols Images, Icons, Statistical Graphs	
		point	line	area	surface	volume				
Symbol	1									
	2									
	3									
Form	size	NA (Not applicable)								
	shape	NA								
	orientation	NA								
	curvature	NA								
	angle	NA								
	closure	NA								
	value									
	hue									
	saturation									
Texture	spacing									
	consistency									
	pattern									
	orientation	NA								
	accent									
	blur									
	transparency									
	shading									
	stereoscopic depth	Point in foreground - background	Line in foreground - background	Area in foreground - background	Surface in foreground - background	Volume in foreground - background	Text in foreground - background	Text in foreground - background	Image in foreground - background	Image in foreground - background
	speed									
Motion	velocity									
	rhythm	Blinking point slow - fast	Blinking line slow - fast	Blinking area slow - fast	Blinking surface slow - fast	Blinking volume slow - fast	Blinking text slow - fast	Blinking text slow - fast	Blinking icons slow - fast	Blinking icons slow - fast



Science Forecast

S1:E1, 2015



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

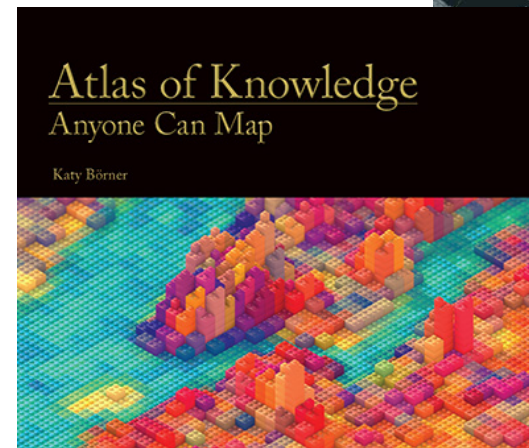
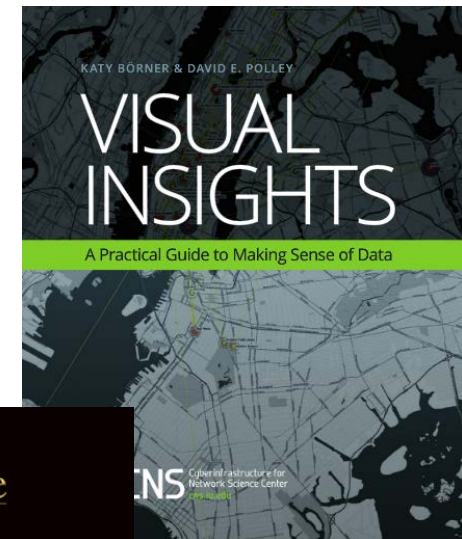
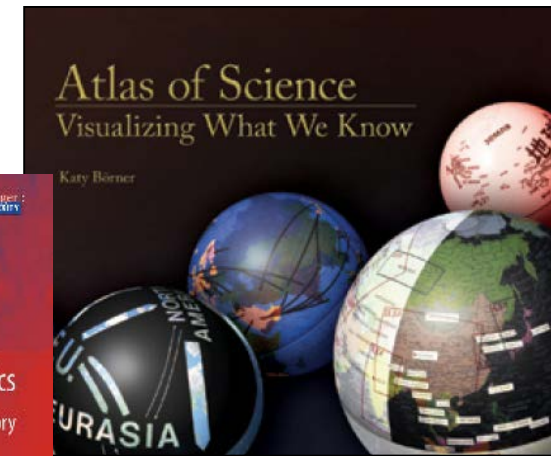
Börner, Katy (2010) **Atlas of Science: Visualizing What We Know**. The MIT Press. <http://scimaps.org/atlas>

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

Katy Börner, Michael Conlon, Jon Corson-Rikert, Cornell, Ying Ding (2012) **VIVO: A Semantic Approach to Scholarly Networking and Discovery**. Morgan & Claypool.

Katy Börner and David E Polley (2014) **Visual Insights: A Practical Guide to Making Sense of Data**. The MIT Press.

Börner, Katy (2015) **Atlas of Knowledge: Anyone Can Map**. The MIT Press. <http://scimaps.org/atlas2>





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Research



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Latest News



Put your money where your citations are: a proposal for a new funding system (website accessed 9/05/13)

Upcoming Events

OCT 1

Katy Börner attends PIUG 2013 Northeast Conference

10.13 Katy Börner presents Mapping Science Exhibit at WSSF

10.15 Ted Polley & Google Team present IVMOOC at EDUCAUSE

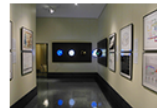
10.22 Katy Börner presents at the SciELO 15 Years Conference

Development



Behind the scenes of the design and development of *AcademyScope*

Outreach



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Videos



Watch Katy Börner's full presentation from TEDxBloomington

Teaching



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