

Connecting the Dots: Museum Visitors and Data Visualization Literacy

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Indiana University, Bloomington, USA

January 25, 2018 | 1:00 PM
Exploratorium Journal Club

CNS Tools and Services are used around the globe.



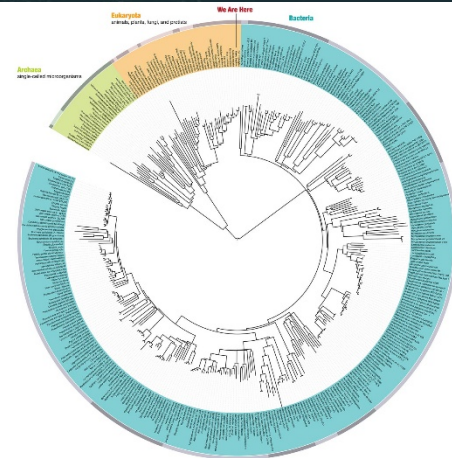
Our mission is to advance datasets, tools, and services for the study of biomedical, social and behavioral science, physics, and other networks. A specific focus is research on the structure and evolution of science and technology (S&T) and the communication of results via static and interactive maps of science.



PLACES & SPACES & MAPPING SCIENCE



Tree of Life



Map of Scientific Collaborations from 2005-2009



scimaps.org

Computed Using Data from Elsevier's Scopus

100

MAPS

in large format, full color, and high resolution.

215

MAPMAKERS

from fields as disparate as art, urban planning, engineering, and the history of science.

24



MACROSCOPE MAKERS

including one whose job title is "Truth and Beauty Operator."

8

MACROSCOPES

for touching all kinds of data.



354

DISPLAY VENUES AND EVENTS

from the Cannes Film Festival to the World Economic Forum.

214



PRESS ITEMS

including articles in *Nature*, *Science*, *USA Today*, and *Wired*.



5



NEW CITIES

visited in 2016 including Ghent, Belgium, and Valencia, Spain.

4,378,916

WEBSITE VISITS

to scimaps.org since 2005.

Macrosopes

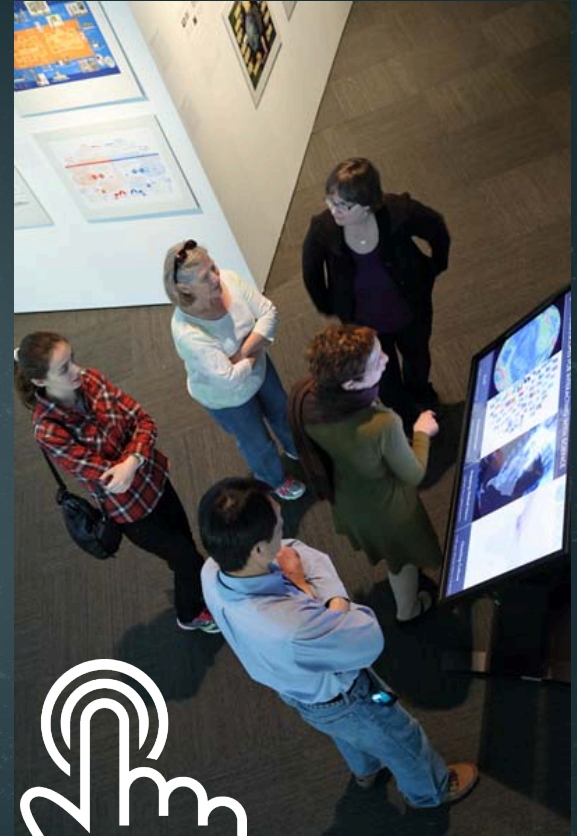
Macrosopes are tools that help people focus on patterns in data that are too large or complex to see unaided.

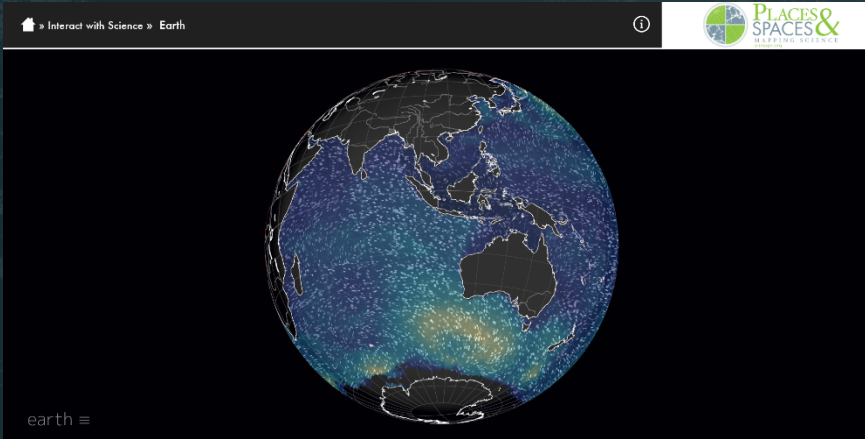




Why move from maps to macroscopes?

- Data visualizations are increasingly interactive.
- Manipulating visualizations can help people understand them better.
- We want visitors to take an active role in using and understanding data.

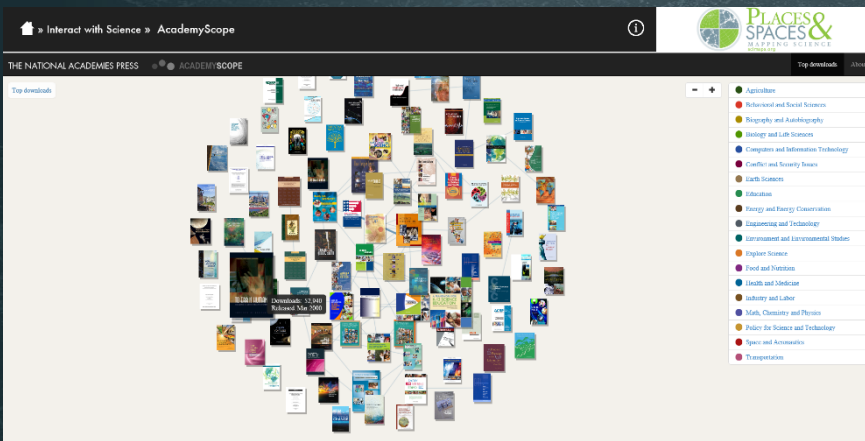




Earth

Cameron Beccario

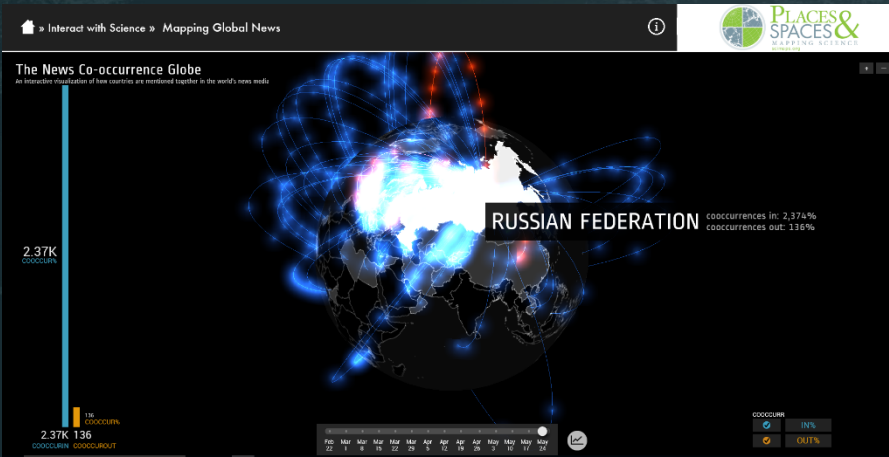
earth.nullschool.net



AcademyScope

National Academy of Sciences and
Cyberinfrastructure for Network
Science Center

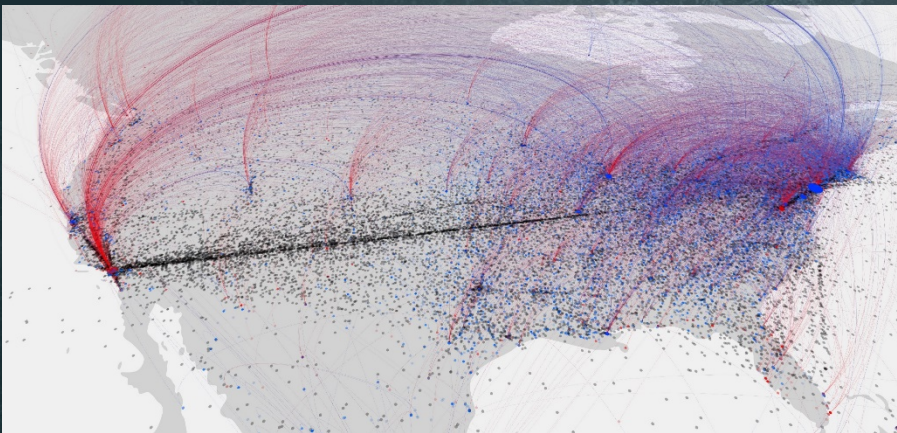
nap.edu/academy-scope/#top-downloads



Mapping Global News

Kalev Leetaru

gdeltproject.org



Charting Culture

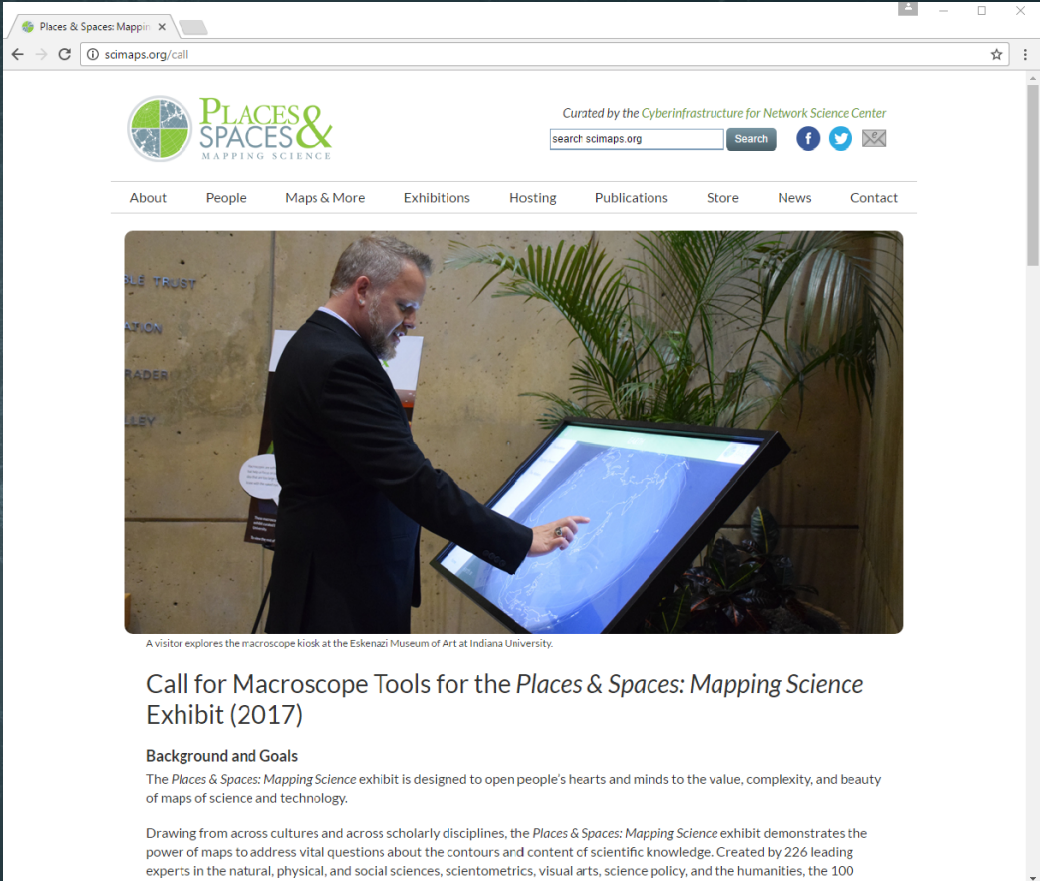
Maximilian Schich and

Mauro Martino

cultsci.net

Join us!

- Submissions due Jan 31, 2018
- Recommend others or submit your own work
- For details: scimaps.org/call



The screenshot shows a web browser window with the URL scimaps.org/call. The page features the logo for "PLACES & SPACES & MAPPING SCIENCE" and a navigation menu with links for About, People, Maps & More, Exhibitions, Hosting, Publications, Store, News, and Contact. A search bar is present with the text "search scimaps.org". A social media bar includes icons for Facebook, Twitter, and Email. The main content area displays a photograph of a man in a suit interacting with a large, illuminated digital display showing a map. Below the photo is a caption: "A visitor explores the macroscope kiosk at the Eskenazi Museum of Art at Indiana University." The main heading for the page is "Call for Macroscope Tools for the *Places & Spaces: Mapping Science* Exhibit (2017)". Underneath, there is a section titled "Background and Goals" which states: "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." The final paragraph reads: "Drawing from across cultures and across scholarly disciplines, the *Places & Spaces: Mapping Science* exhibit demonstrates the power of maps to address vital questions about the contours and content of scientific knowledge. Created by 226 leading experts in the natural, physical, and social sciences, scientometrics, visual arts, science policy, and the humanities, the 100

Pathways

Sense-Making of Big Data

The project examined the data visualization literacy of over 900 youth and adult visitors across five US science museums. The New York Hall of Science and Science Museum of Minnesota are both involved as partner institutions, providing financial support, facilities, and collaborative research. Data collection took place at the New York Hall of Science, the Marian Koshland Science Museum, COSI in Columbus Ohio, and Wonderlab Museum in Bloomington, IN.



Pathways: Sense-Making of Big Data. NSF ISE DRL-1223698 Award (Katy Börner, Adam V. Maltese, Joe E. Heimlich, Stephen Miles Uzzo, Paul Martin, and Sasha Palmquist, \$250,000) 2012.07.01 - 2015.06.30.



Participants from the November 2013 Pathways Workshop at the Science Museum of Minnesota



Jax and the Big Data Beanstalk, a Science Museum of Minnesota theater piece funded by the NSF, introduces museum visitors to big data visualizations and science maps

What is Big Data?

More than two-thirds of visitors interviewed said that they had not previously heard the phrase “Big Data.”

—Sense Making of Big Data, Heimlich, Tranby, Wojton 2014

“Important information. Something everybody relates to, but doesn’t understand.”

—Project participant

“[It] gives me anxiety. I don’t know and I don’t like it.”

—Project participant

Big Data Insight Needs Sort

Looking for generalizable ways visitors engage with and then make meaning of big data sets.

Eggs
Crackers
Lasagna
Apples
Tofu
Almonds



Meaning making through data representation
construction and deconstruction

For better comprehension

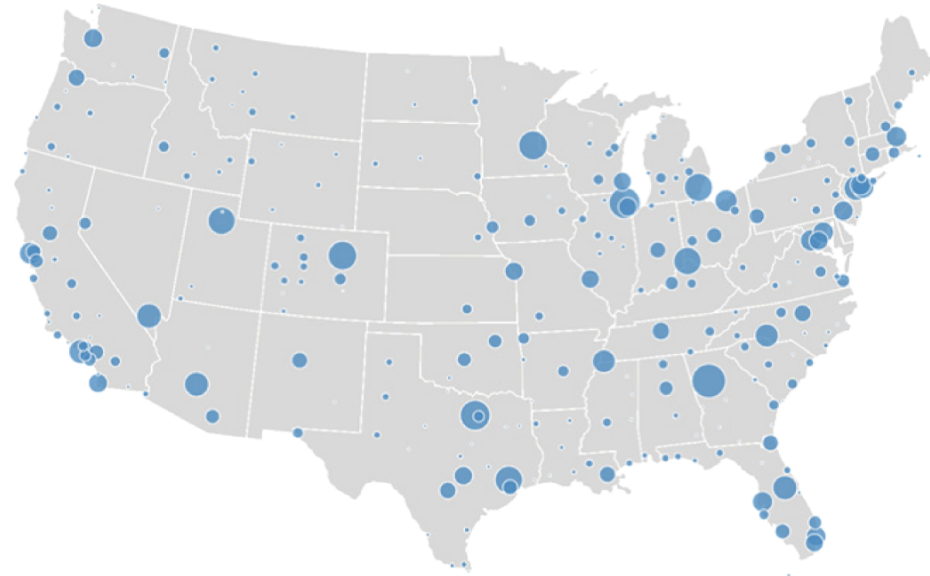
Build a sandwich . . .



. . . instead of peeling an onion.



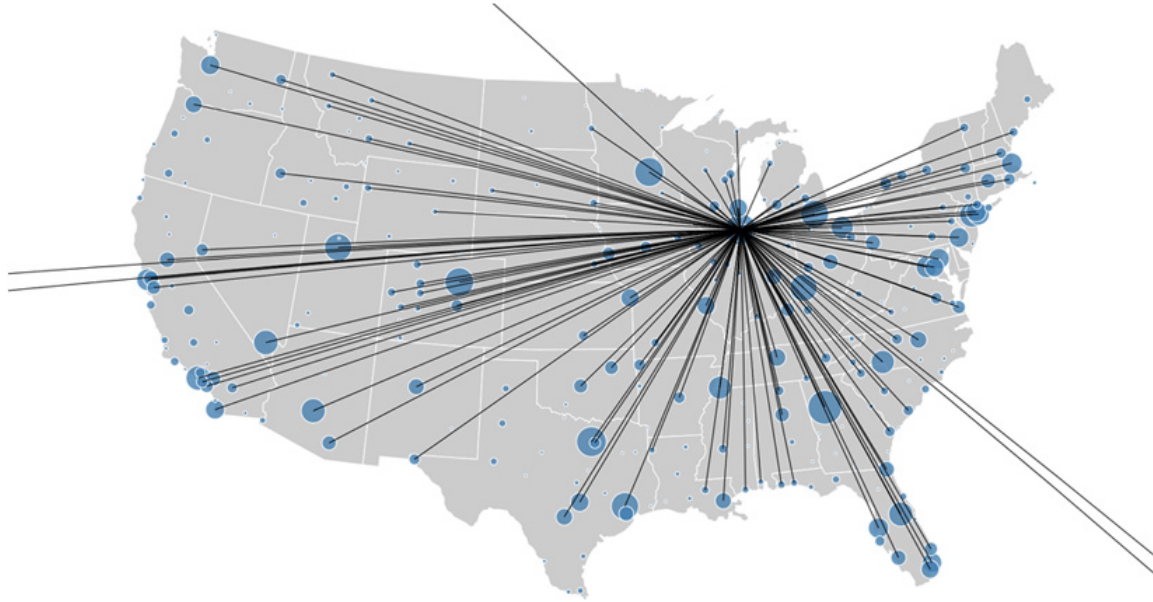
Circle size equals number of flights per day.



Tucson International, 2008

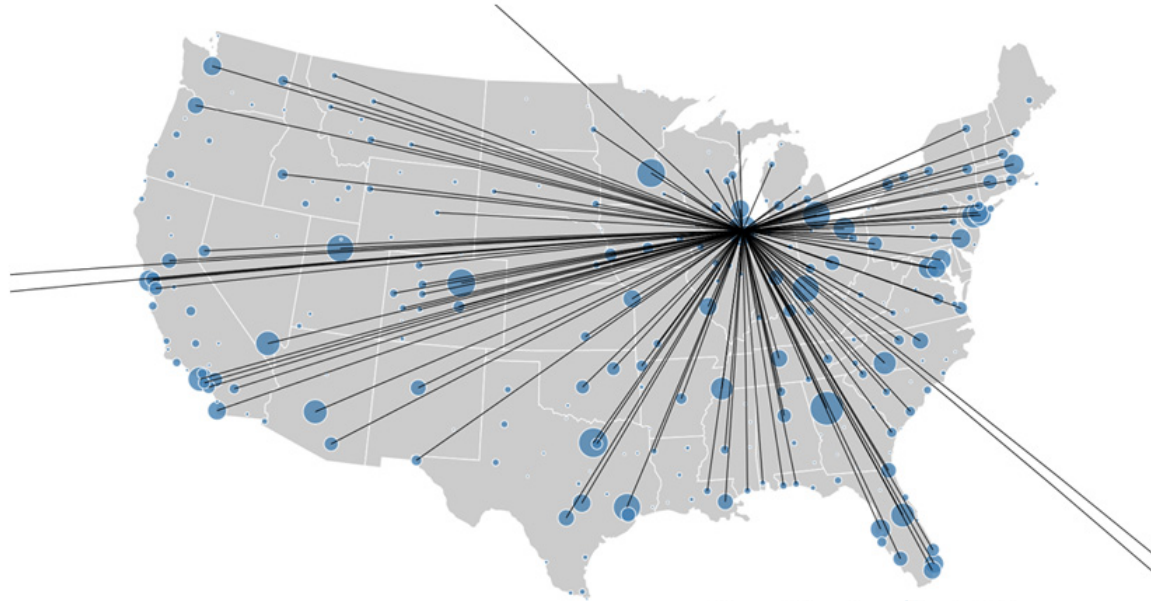


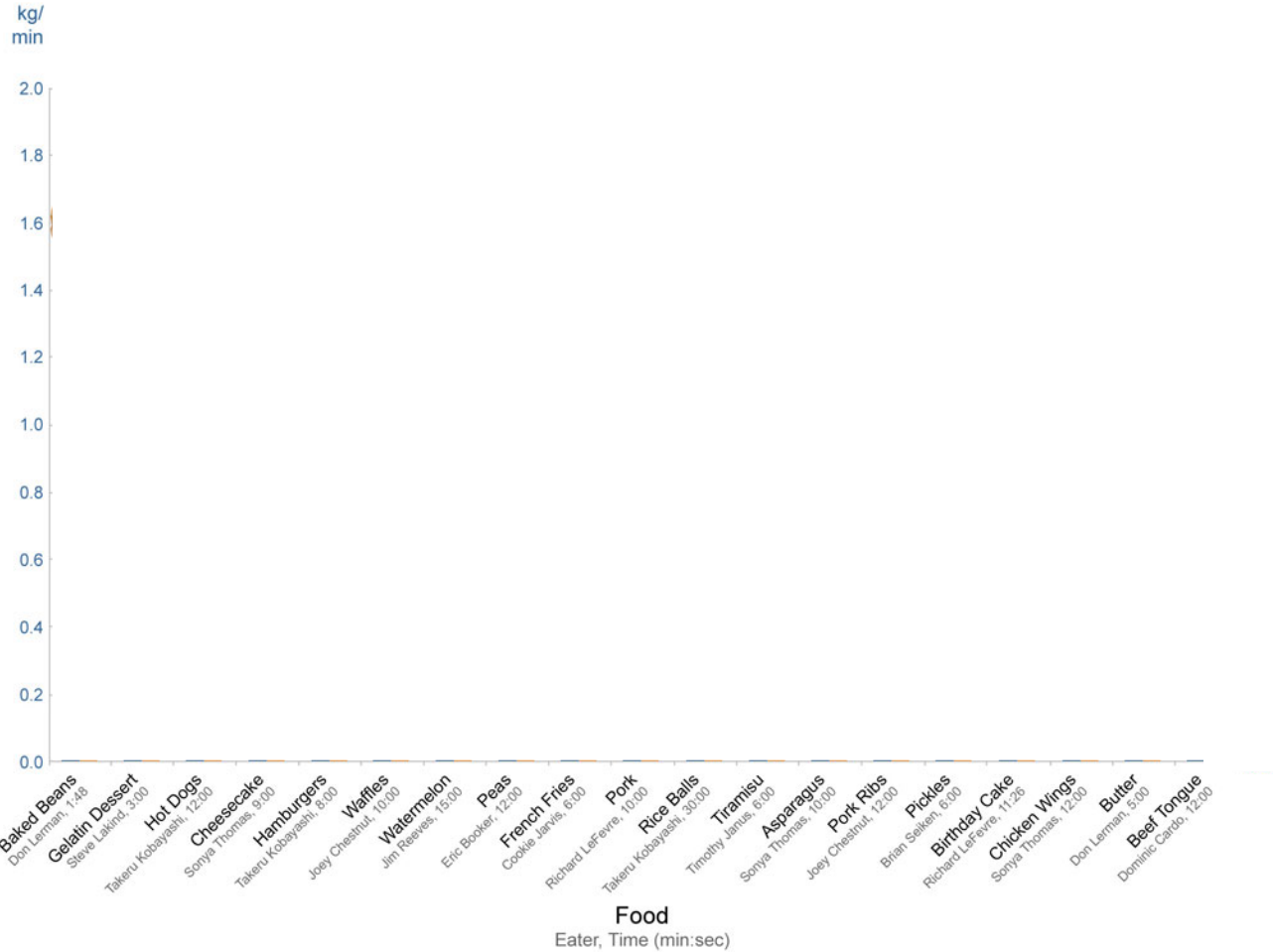
Links represent flight connections.

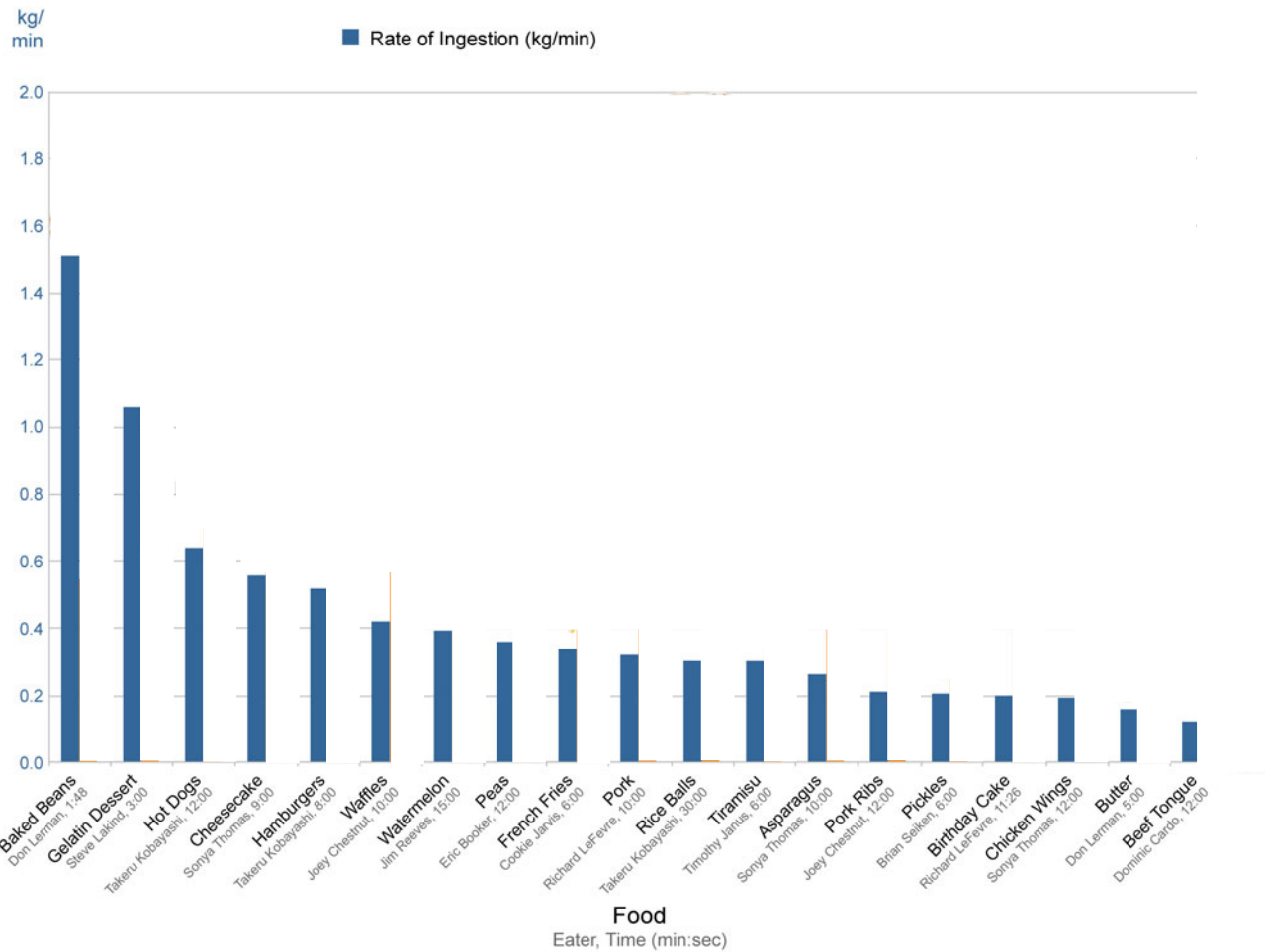


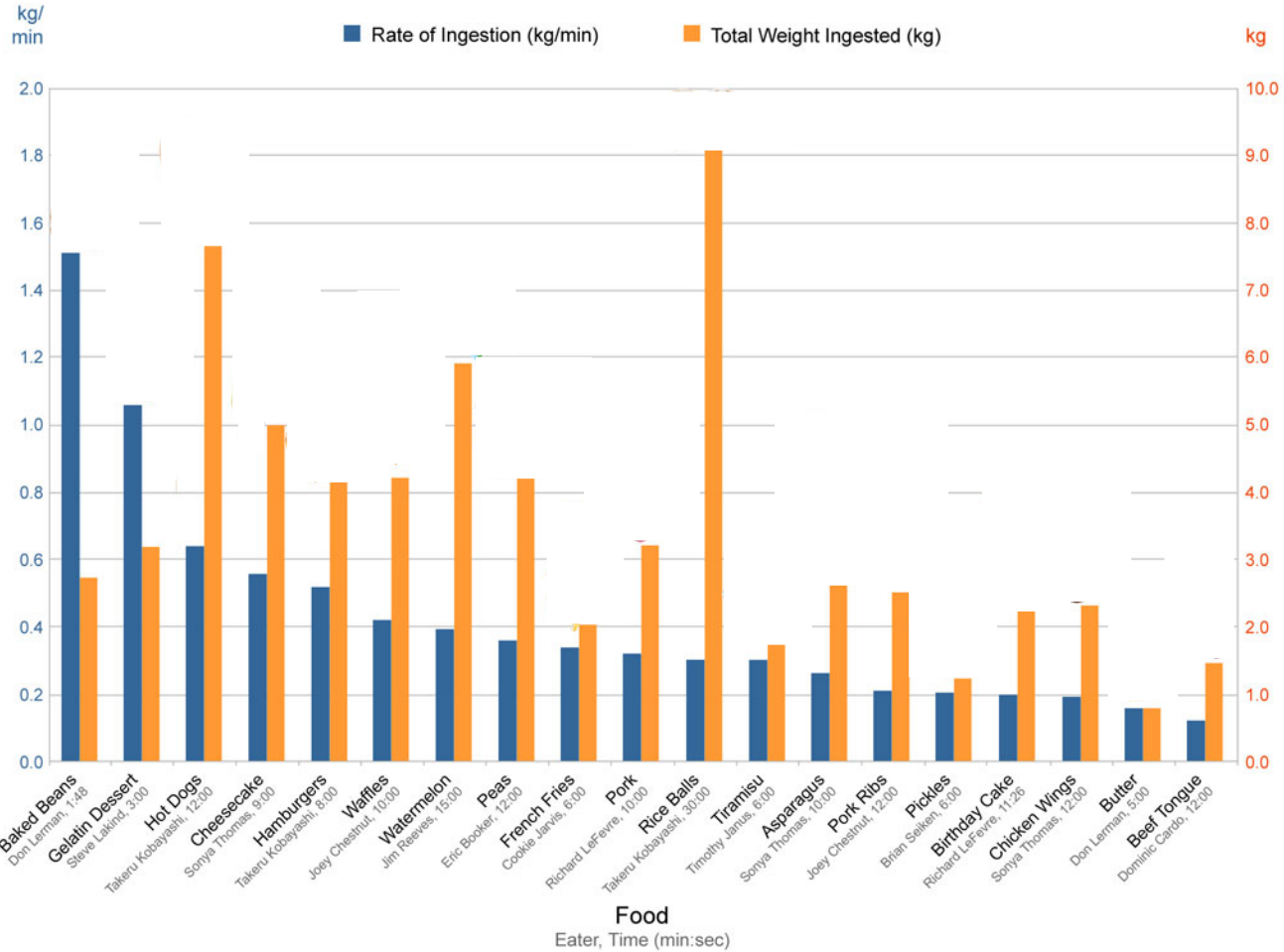
Airports reachable from Chicago O'Hare International Airport in 2008

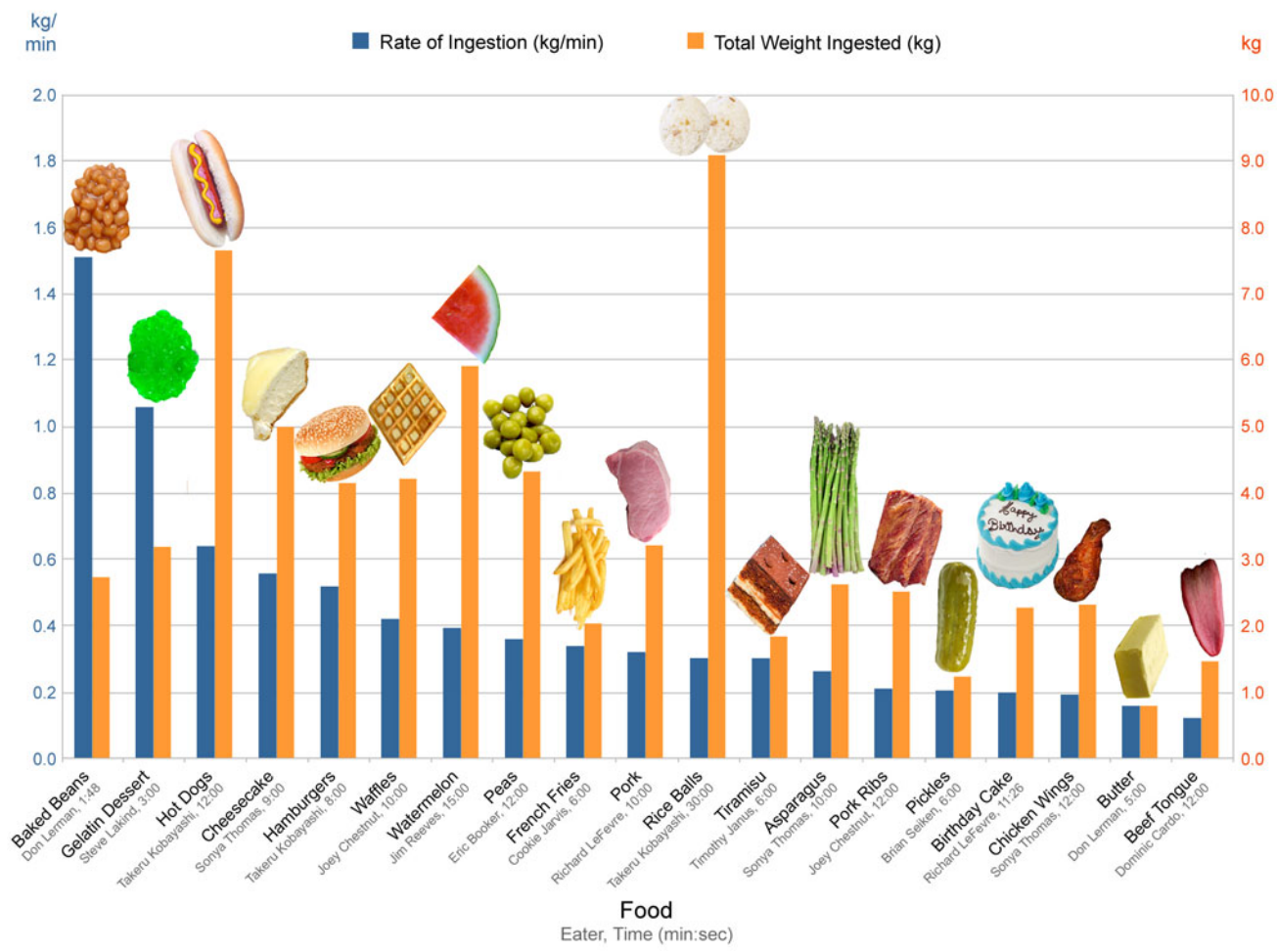
Circle size equals number of flights per day.

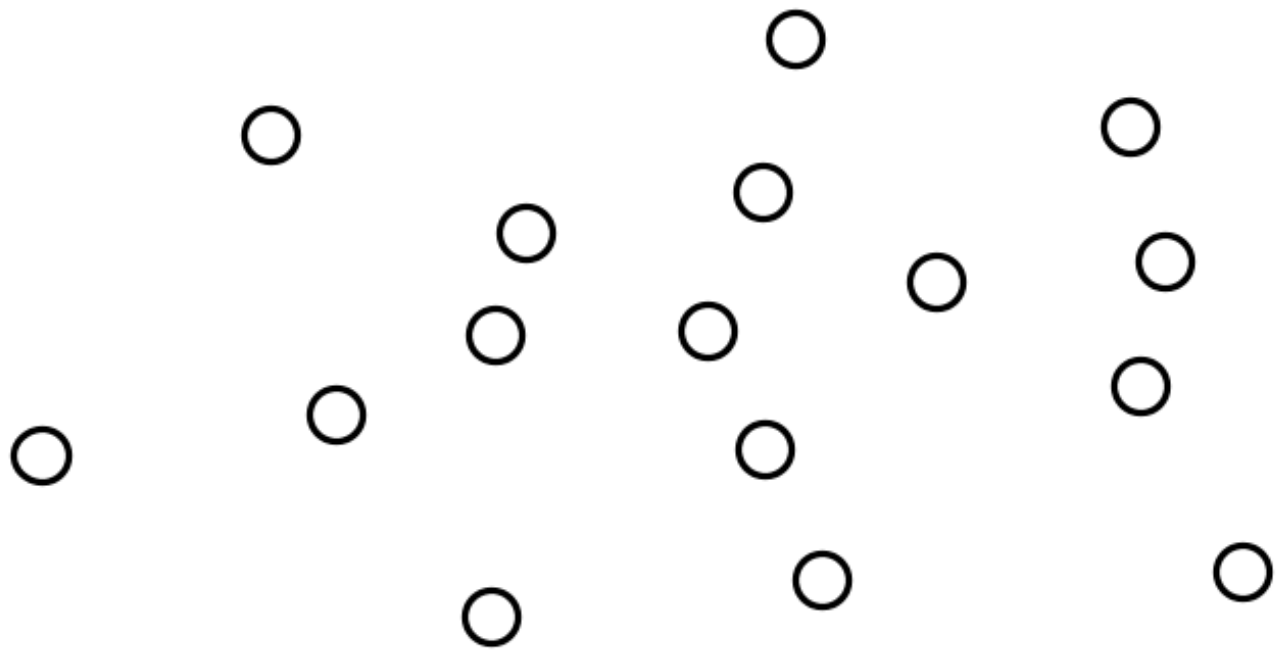


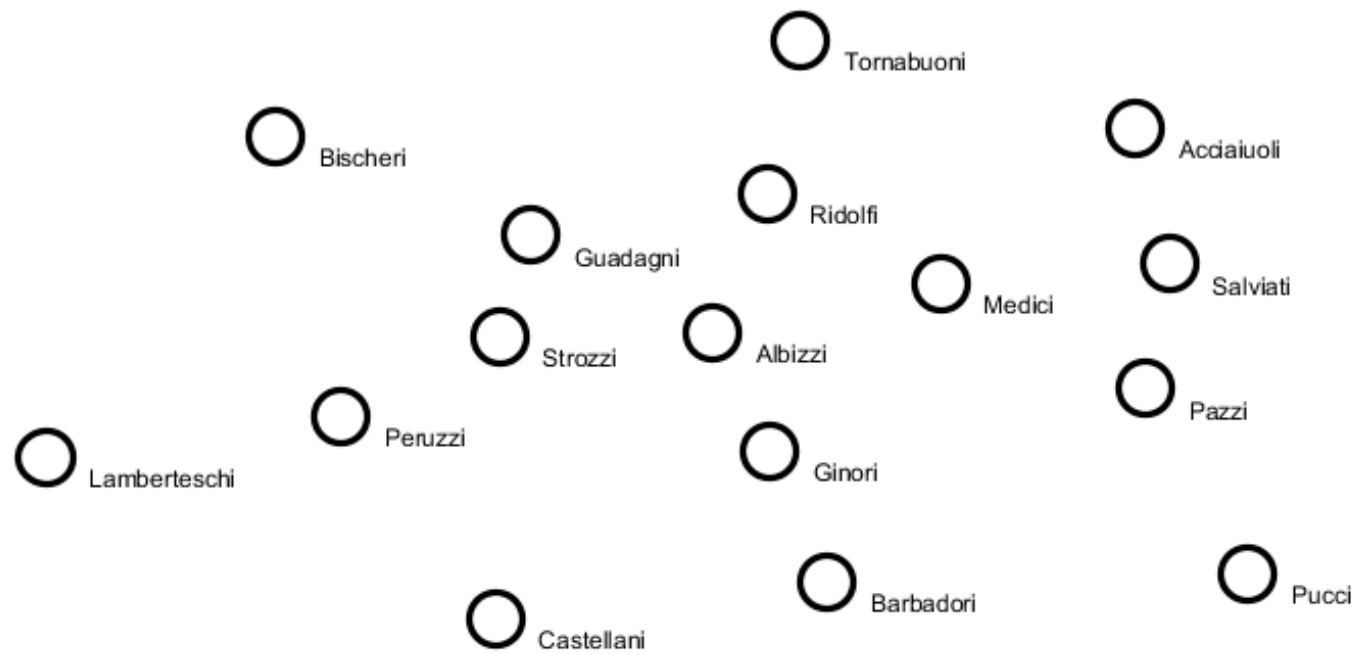




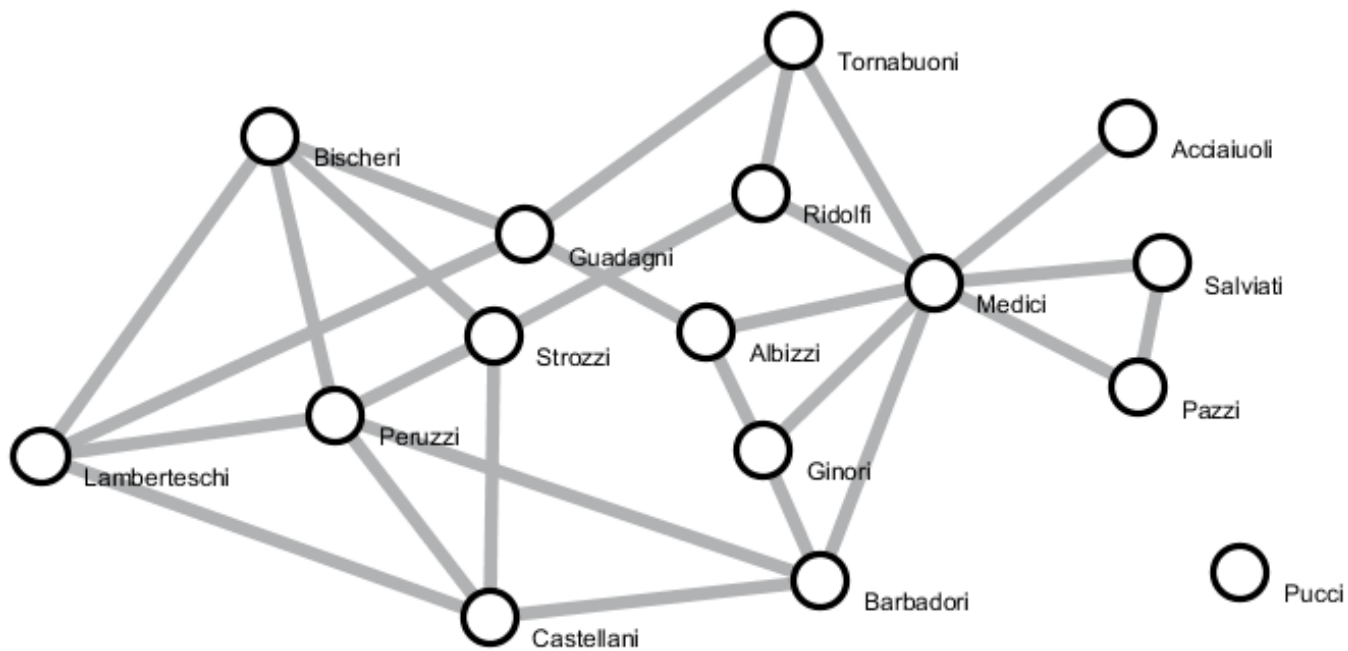




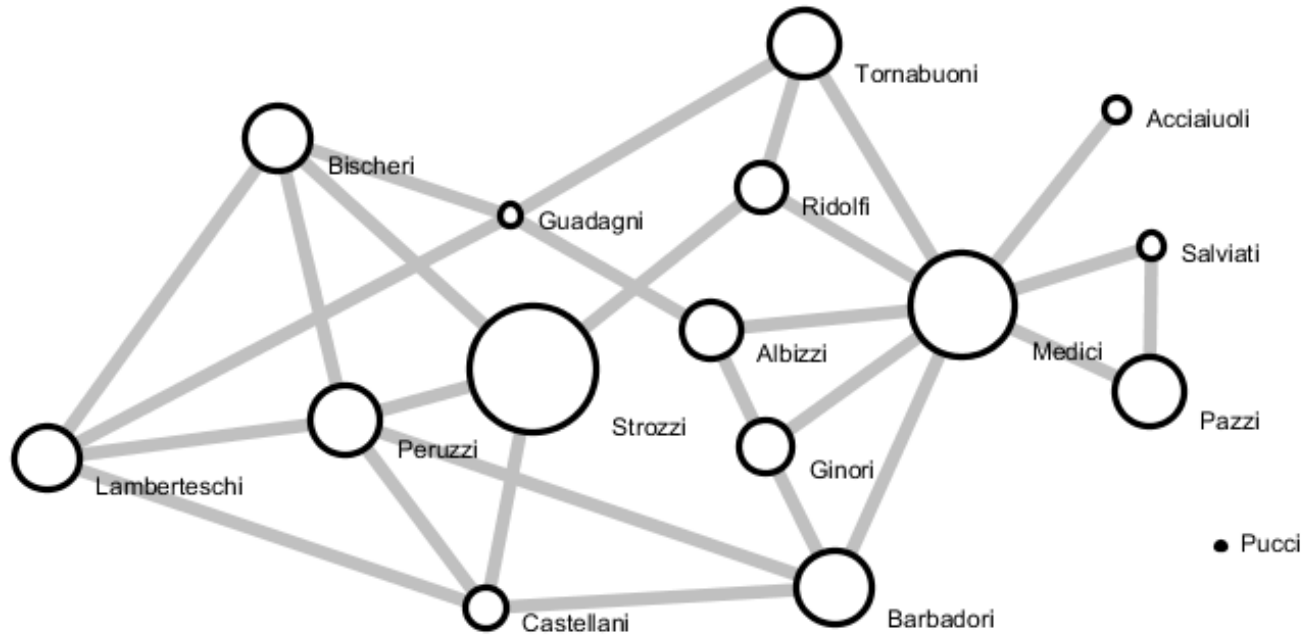




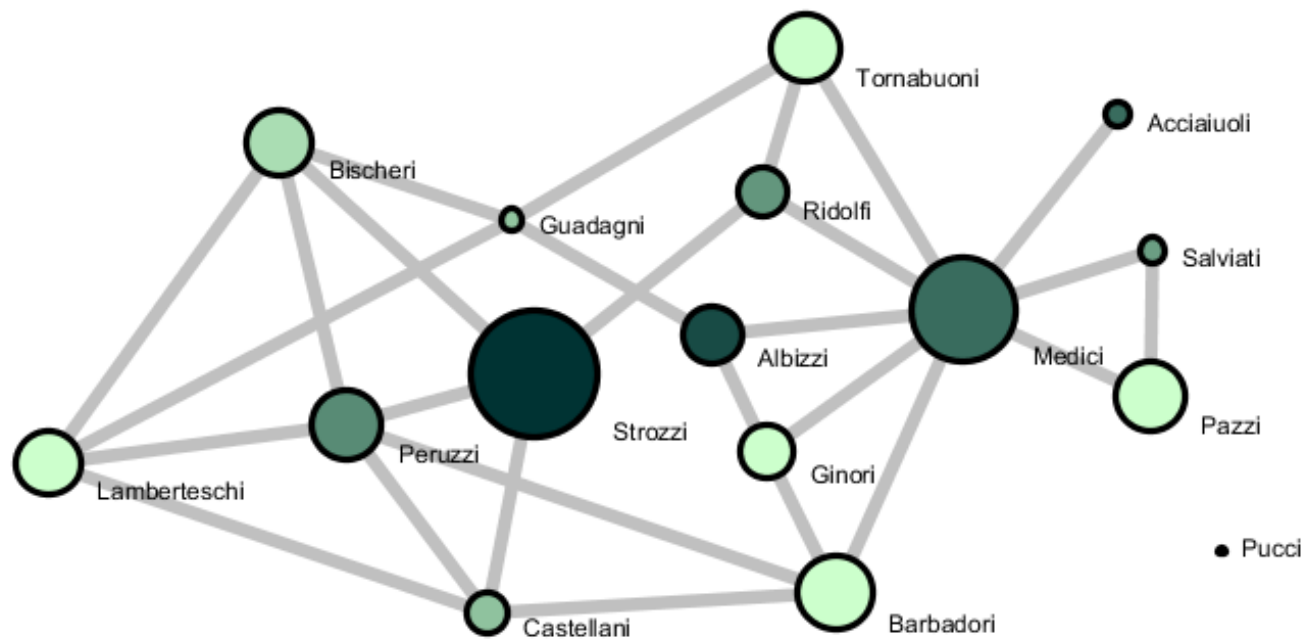
Label: Family Name



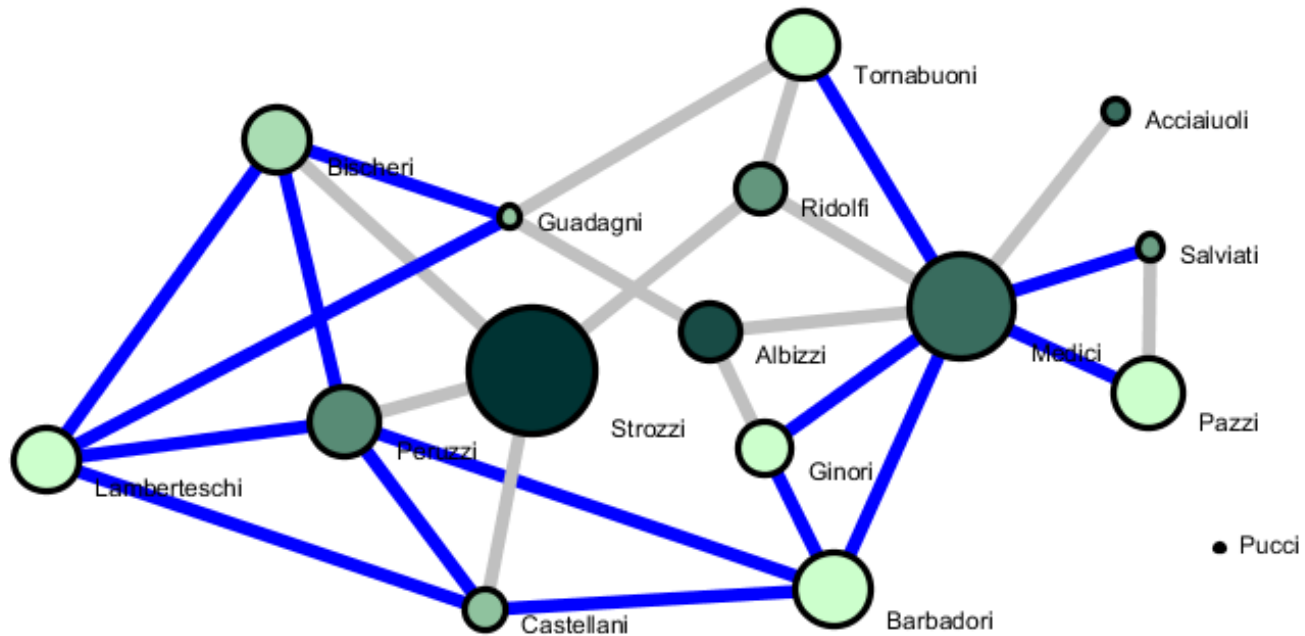
Label: Family Name



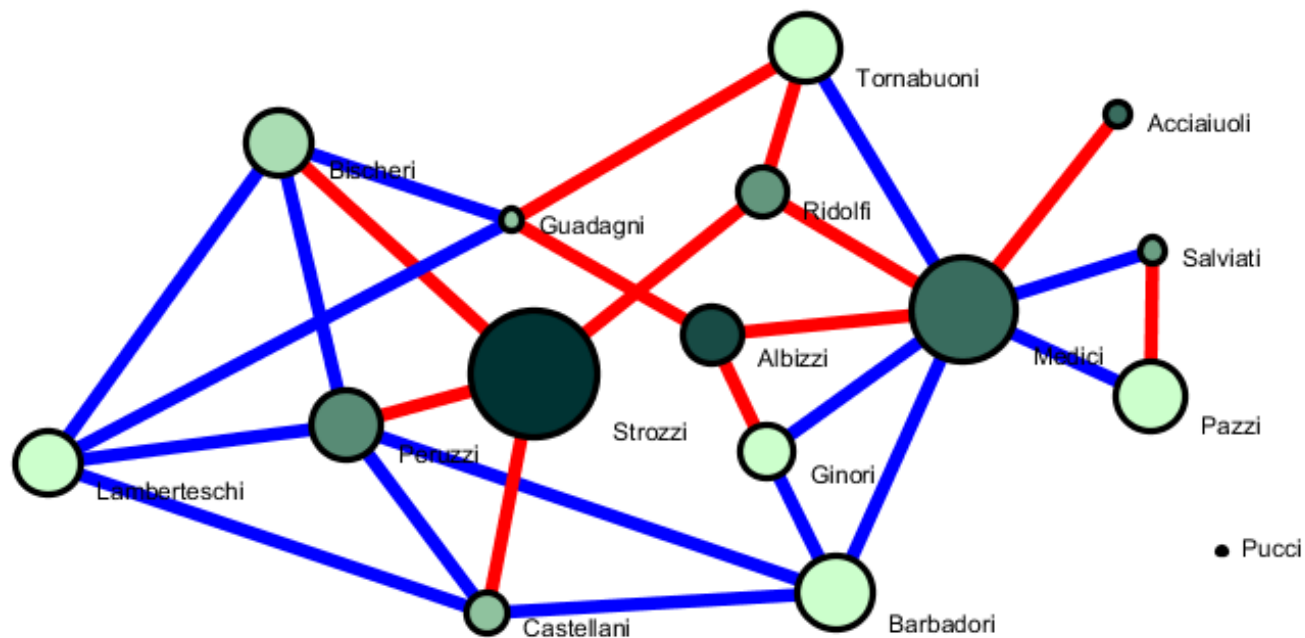
Circle size: Family's net wealth (in thousands of lira) in year 1427.



Circle color: Number of seats on the civic council held 1282-1344.

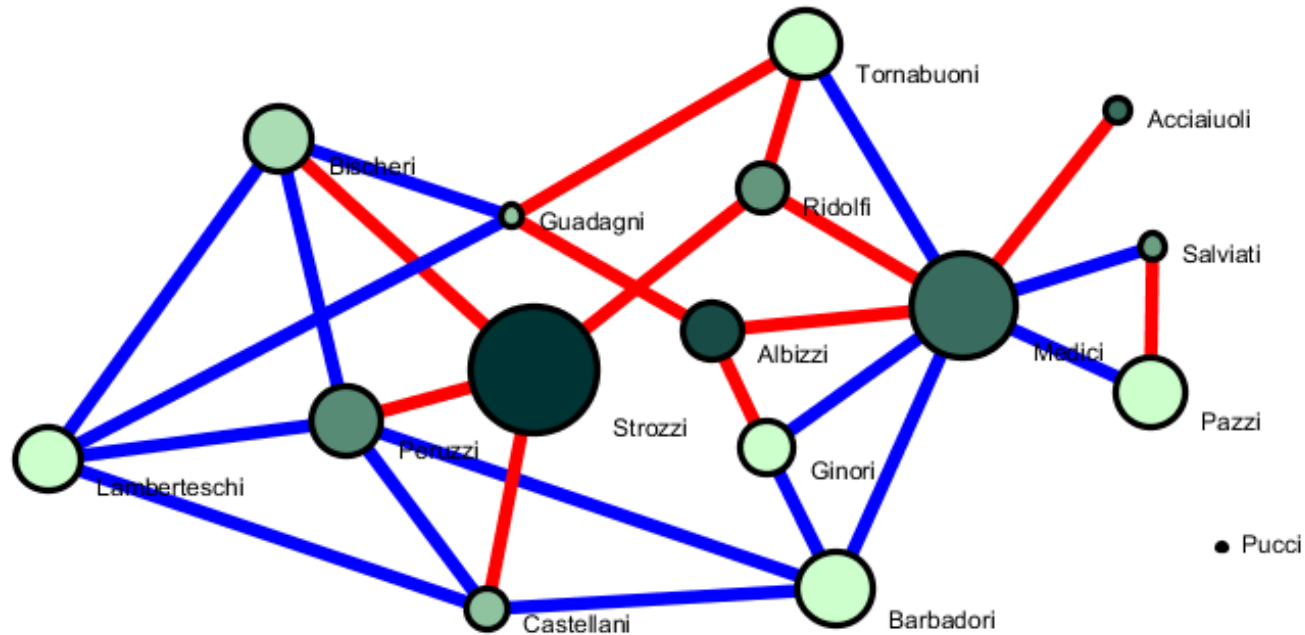


Link color: Business ties, e.g., loans, credits, and joint partnerships.



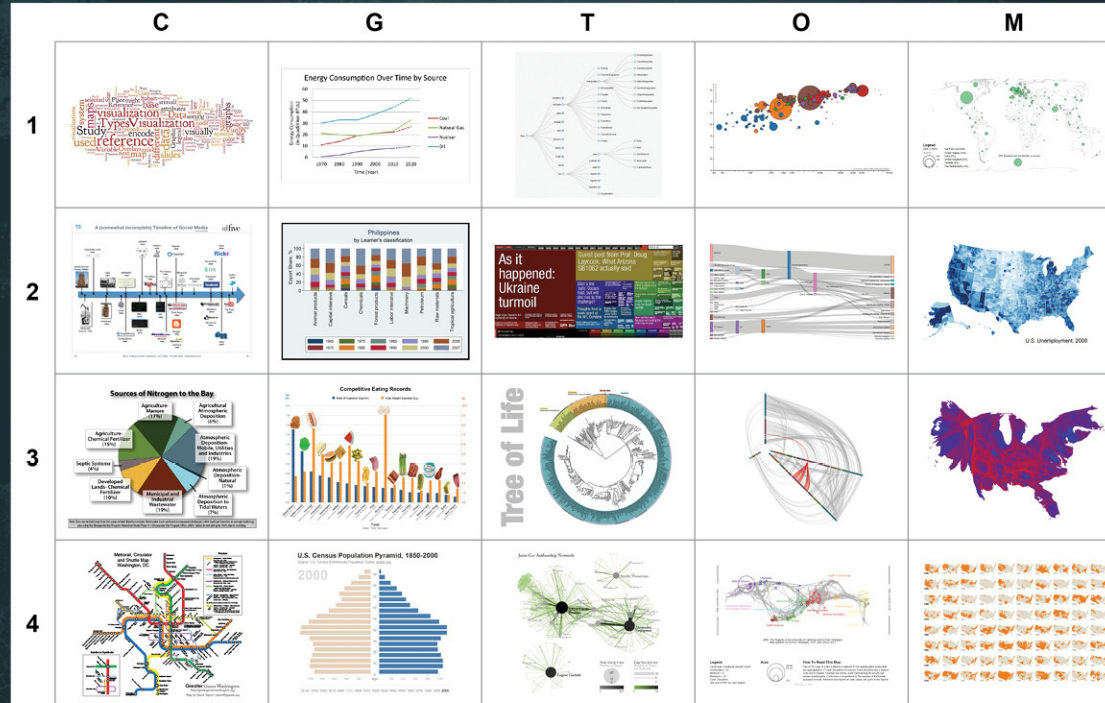
Link color: Marriage alliances.

Padgett's Florentine Families



Link color: Marriage alliances.

Data Visualization Literacy: Can 273 Science Museum Visitors Read 20 Information Visualizations?



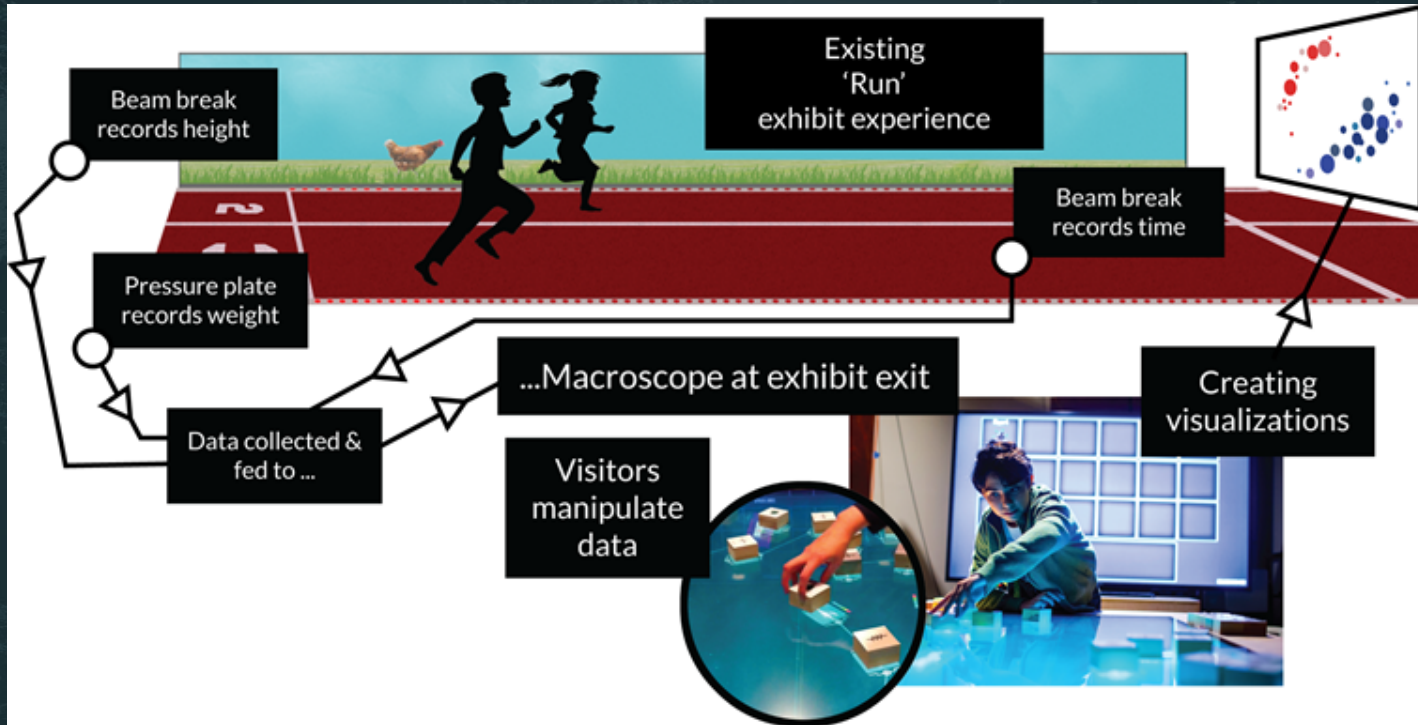
Börner, Katy, Joe E. Heimlich, Russell Balliet, and Adam V. Maltese. (Submitted). "Investigating Aspects of Data Visualization Literacy Using 20 Information Visualizations and 273 Science Museum Visitors". Information Visualization.

Visualization Types (Reference Systems)

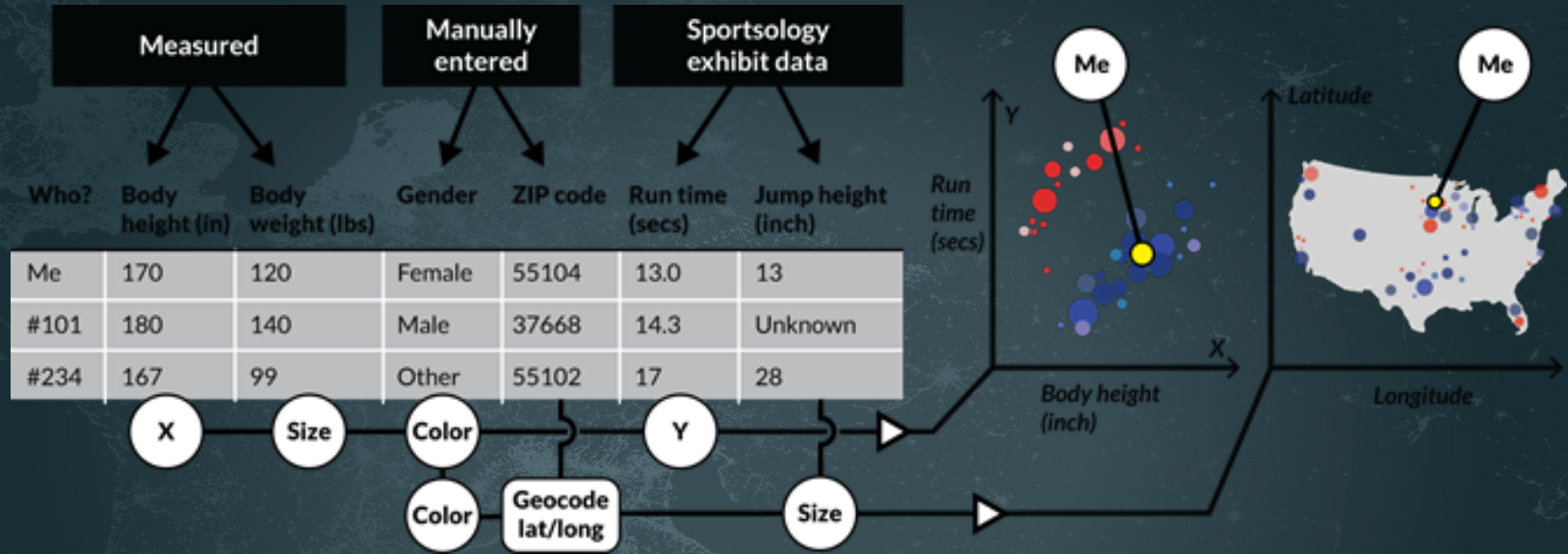
1. **Charts:** No reference system—e.g., Wordle.com, pie charts
2. **Tables:** Categorical axes that can be selected, reordered; cells can be color coded and might contain proportional symbols. Special kind of graph.
3. **Graphs:** Quantitative or qualitative (categorical) axes. Timelines, bar graphs, 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.

Intro to AISL project

- Research into how to define and test for data visualization literacy
- Develop the xMacroscope, a platform for research and for exhibit development



Sketch of the *Run* exhibit including data collection (top) and macrocope add-on at exhibit exit that lets interested visitors explore more complex data visualizations (lower right).



xMacroscope general concept—Raw data on left is converted to a visualization on the right by dragging and dropping (or connecting) column headers to axes, paint buckets, size, and shape.

Who is willing to share what information, when, and with whom?

Data Visualization Literacy Literature Review:
Sharing Personal Information

E. Elaine T. Horr, Ph.D.

Joe E. Heimlich, Ph.D.

October 2017



Resources

IVMOOC

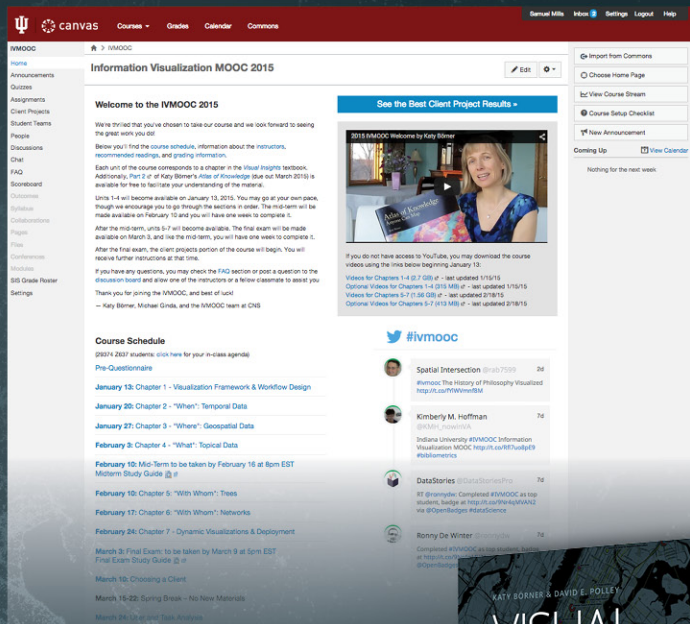
Information Visualization MOOC

The Information Visualization MOOC provides an overview about the state of the art in information visualization, teaching the process of producing effective visualizations that take the needs of users into account.

The inaugural IVMOOC, which launched in January 2013, attracted participants from more than 100 countries. It is one of the first MOOCs offered by IU and the first to offer an opportunity for students to work in teams with real clients. All registrants gain free access to the Scholarly Database and the Sci2 Tool.

The course can be taken for three Indiana University credits as part of the Online Data Science Program offered by the School of Informatics and Computing.

The course will return in January 2016. Learn more at ivmooc.cns.iu.edu.



Information Visualization MOOC 2015

Welcome to the IVMOOC 2015

We're so glad that you've chosen to take our course and we look forward to seeing the great work you do!

Below you'll find the course schedule, information about the instructors, recommended readings, and pricing information.

Each unit of the course corresponds to a chapter in the *Visual Insights* textbook. Additionally, Part 2 of Katy Börner's *Atlas of Knowledge* (due out March 2016) is available for free to facilitate your understanding of the material.

Units 1-4 will become available on January 13, 2015. You may go at your own pace, though we encourage you to go through the sections in order. The mid-term will be made available on February 13 and you will have one week to complete it.

After the mid-term, units 5-7 will become available. The final exam will be made available on March 3, and like the mid-term, you will have one week to complete it.

After the final exam, the client projects portion of the course will begin. You will receive further instructions at that time.

If you have any questions, you may check the FAQ section or pose a question to the discussion board and give one of the instructors or a fellow student a warm-up to assist you. Thanks for joining the IVMOOC, and best of luck!

— Katy Börner, Michael Good, and the IVMOOC team at CNS

Course Schedule

(2014-2015 students: [click here](#) for your in-class schedule)

Pre-Questionnaire

January 13: Chapter 1 - Visualization Framework & Workflow Design

January 20: Chapter 2 - "When": Temporal Data

January 27: Chapter 3 - "Where": Geospatial Data

February 3: Chapter 4 - "What": Topical Data

February 10: Mid-Term to be taken by February 16 at 8pm EST
[Midterm Study Guide](#)

February 10: Chapter 5: "With Whom": Trees

February 17: Chapter 6: "With Whom": Networks

February 24: Chapter 7 - Dynamic Visualizations & Deployment

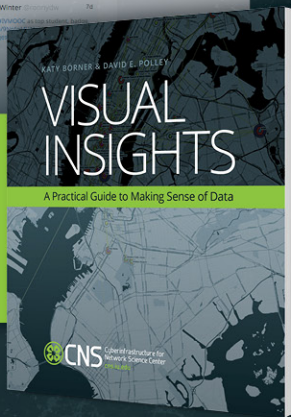
March 3: Final Exam: to be taken by March 9 at 8pm EST
[Final Exam Study Guide](#)

March 10: Choosing a Client

March 18-22: Spring Break - No New Materials

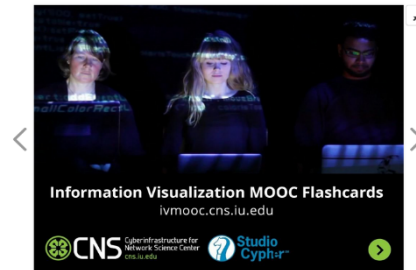
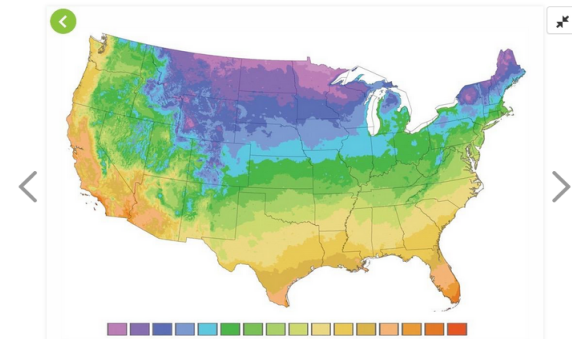
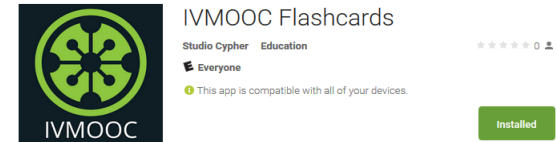
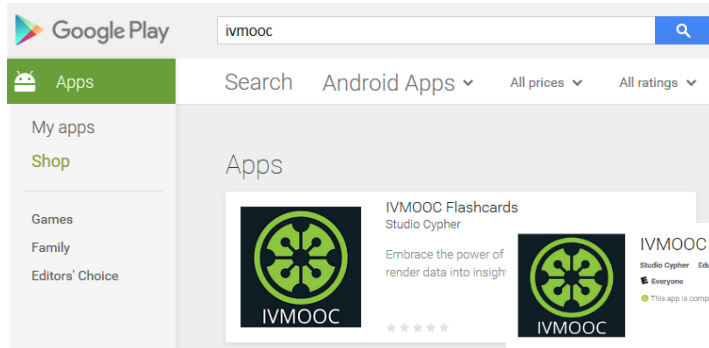
March 29: On a new Book Analysis

This IVMOOC companion textbook offers a gentle introduction to the design of insightful visualizations. It seamlessly blends theory and practice, giving readers both the theoretical foundation and the practical skills necessary to render data into insights.



IVMOOC App – More than 60 visualizations

The “IVMOOC Flashcards” app can be downloaded from Google Play and Apple iOS stores.

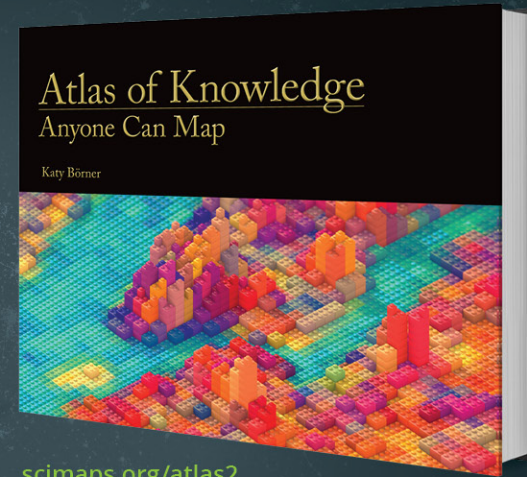


Enjoy the first two books in Katy Börner's 3-Part *Atlas* series



scimaps.org/atlas1

Atlas of Science, featuring more than thirty full-page science maps, fifty data charts, a timeline of science-mapping milestones, and 500 color images, serves as a sumptuous visual index to the evolution of modern science and as an introduction to “the science of science”—charting the trajectory from scientific concept to published results.



scimaps.org/atlas2

The *Atlas of Knowledge* introduces a theoretical visualization framework meant to empower anyone to systematically render data into insights. It aims to teach “timeless” knowledge that holds true over a lifetime while referring to an extensive set of references for “timely” advice on what tool and workflow is currently the best for answering a specific question.



facebook.com/cnscenter



[@cnscenter](https://twitter.com/cnscenter)

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>

Börner, Katy (2018) **Atlas of Forecasts: Predicting and Broadcasting Science, Technology, and Innovation**. The MIT Press.

