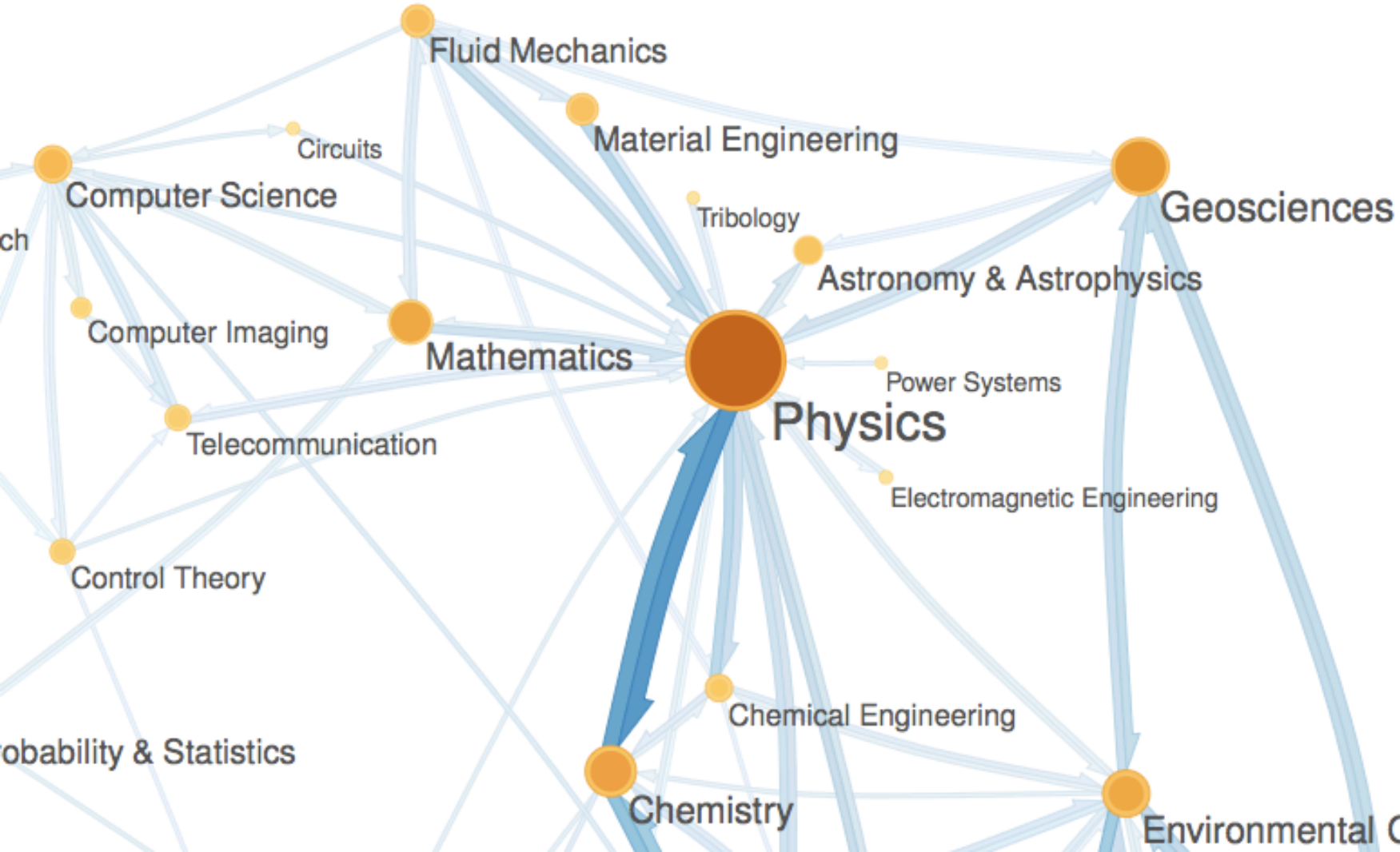
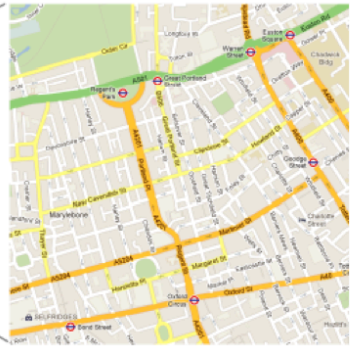
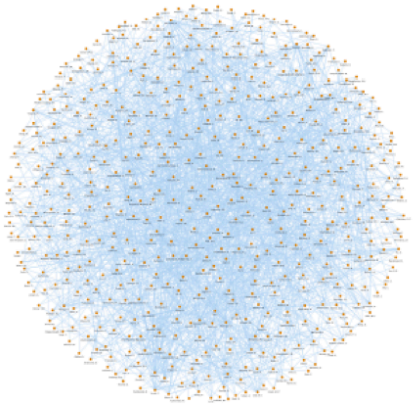
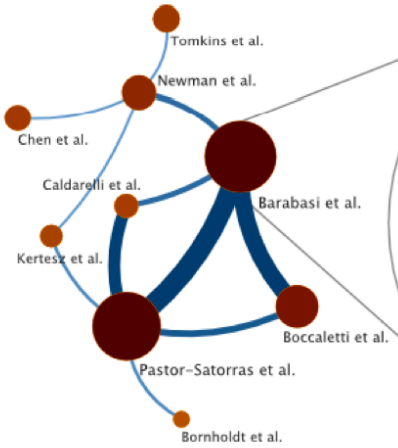
Mapping Knowledge Networks

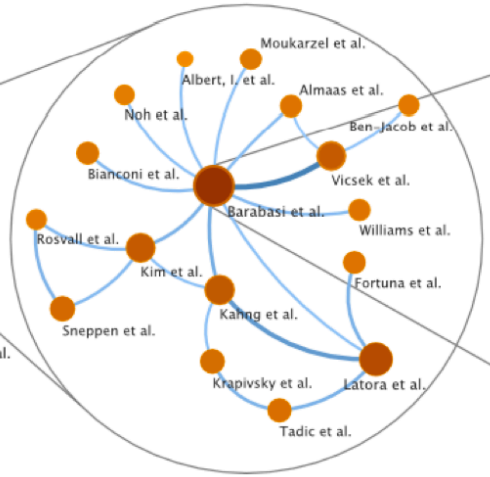
Jevin West, Information School, University of Washington








Tomkins et al.
Newman et al.
Chen et al.
Caldarelli et al.
Barabasi et al.
Kertesz et al.
Boccaletti et al.
Pastor-Satorras et al.
Bornholdt et al.


Moukarzel et al.
Albert, I. et al.
Almaas et al.
Noh et al.
Ben-Jacob et al.
Bianconi et al.
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Barabasi et al.
Williams et al.
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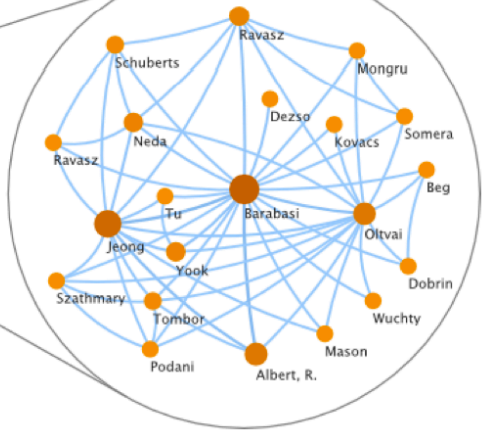
Latora et al.
Tadic et al.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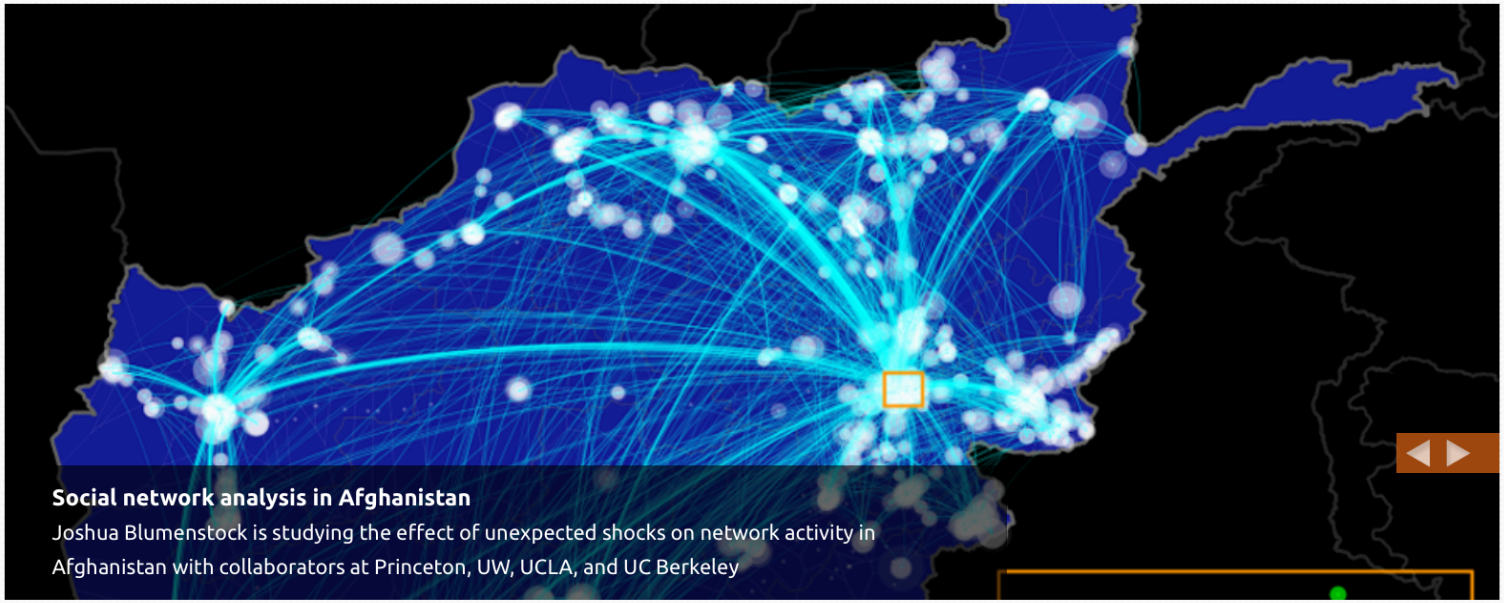
Ravasz
Beg
Tu
Barabasi
Oltvai
Jeong
Yook
Dobrin
Szathmary
Tombor
Wuchty
Mason
Podani
Albert, R.

Data

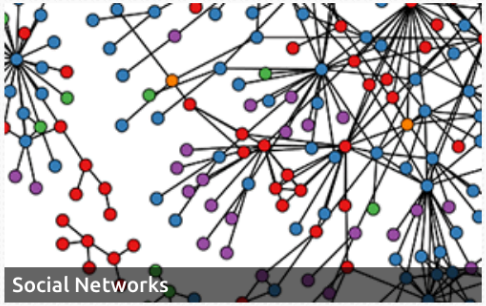
Compressing ⟷ Finding patterns

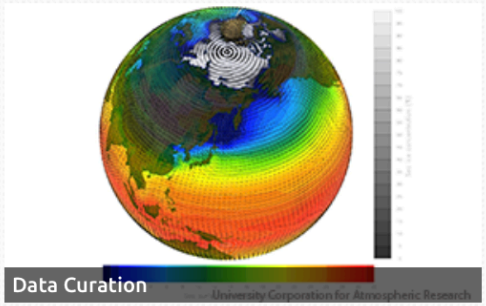
If we can find a good code for describing flow on a network, we will have solved the dual problem of finding the important structures with respect to that flow.

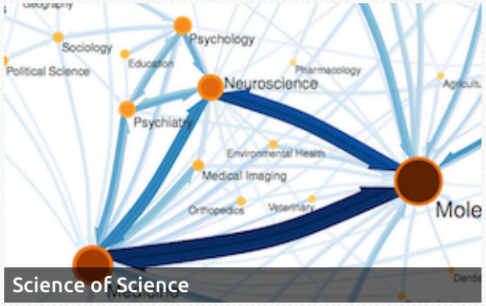
Minimal Description Length (MDL) Statistics



Research Focus Areas







What We Do

Overview

Over the course of the last decade many disciplines have evolved from recording observations in laboratory notebooks to the use of instruments capable of digitally recording many gigabytes of data in a day. This abundance of data provides unprecedented opportunities for discovery. Tapping its potential requires the application of sophisticated new computational techniques operating on large scale storage, computational and network resources. Since its creation in 2008, the eScience Institute has worked to create the intellectual and physical infrastructure needed to meet this challenge.

At the core of the eScience Institute are individuals who have proven track records in developing and applying advanced computational methods and tools to real world problems. Their task is to seek out and engage researchers across disciplines where eScience approaches are likely to have the greatest impact. To ensure that researchers have access to the necessary physical infrastructure, the Institute has undertaken coordinated planning and support for advanced local and remote computational platforms. This includes developing relationships with commercial and non-commercial service providers as well as the development of shared facilities on campus. This support extends to assistance in the preparation of select proposals where we are able to focus resources, improving their chances for success.

Also in... What We Do

Appliance Gallery
Find and use the eScience Institute's virtual machines equipped with software useful for specific applications.
Campus Compute & Storage
Learn about what UW is doing to support scalable scientific computing on campus
Consulting & Services
From algorithm development to database creation to cloud computing, we can help.
Projects
Explore some of our current collaborations with research scientists.
Relevant Courses
View a list of courses offered in eScience disciplines.
SQLShare Success Stories
Tools
Whether it's database management, visualization, or developer tools, learn about tools we can help you use.

Latest eScience News

Data Science Incubation Program - Winter 2016
2 hours 4 min ago

Ben Marwick On How Computers Broke Science

tps://ischool.uw.edu/current" in a new tab

About

The Future of Libraries

Over the past 20 years, scholars across many fields have engaged in speculative thinking about the future of libraries with many questions about the future of scholarship, research, the preservation of cultural heritage, and the provision of information services to communities, to name a few. iSchool faculty have a breadth and depth of expertise that positions the School uniquely and strategically to explore the purpose, shape and function of libraries and the role of librarians in future information environments worldwide. Our strong Master of Library and Information Science (MLIS) program takes advantage of the many research interests and expertise within the iSchool and educates leaders who will continue to shape our future.

Our work cuts across technology, design, digital youth, Native North American Indigenous Knowledge, data resources and services, libraries, data science, policy and ethics, social media, disaster recovery, community engagement, and information management. Our intention with a strategic focus on "The Future of Libraries" is to lead and collaborate with our peers in the academy and the profession, and to direct and influence the practice of librarianship and the role that libraries must play in the lives of people and communities in the 21st century.

iFacts

"In 100 years, the iSchool has grown from 10 students to 150 in the 1980s and 90s to almost 800 today with plans to grow to over 1,000 – continuing to meet the needs of the ever-expanding information field."

Mike Eisenberg
Professor and Dean Emeritus

Meet the Dean

News & Events

Headlines
Feature Stories
Events
Videos
Documents That Changed the World
Social Hub

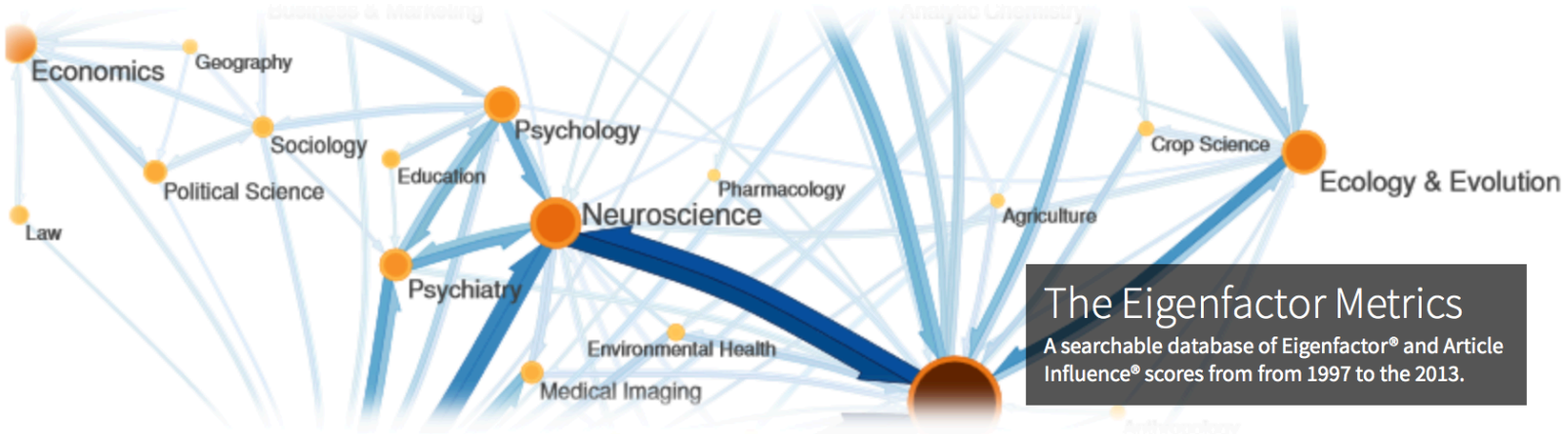
Technology & Social Change Group to work with Gates Foundation Global Libraries on legacy strategy

The University of Washington Information School's Technology & Social Change Group (TASCHA), including their longstanding research collaborators at the US Impact Studies group, has been identified as one of three lead legacy partners expected to continue the work of the Bill & Melinda Gates Foundation's Global Libraries initiative and build on their 20 year, $1 billion global investment to help bridge digital divides both in the United States and globally.

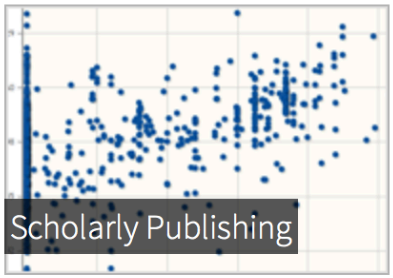
"This is a tremendous honor. TASCHA strives to conduct research that makes a difference in the world, and it will be a great privilege to work with Global Libraries and the other expected legacy partners to ensure public libraries have what they need to remain as critical community assets in a rapidly changing technological landscape," said Chris Coward, director of TASCHA.

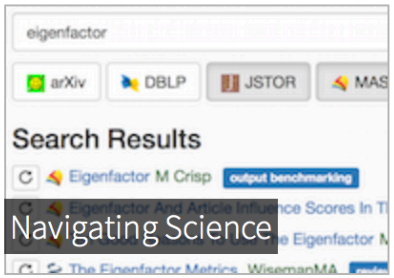
In May, the Gates Foundation announced that the Global Libraries initiative would be concluded over the next three to five years, but stressed its intention to develop a legacy strategy framework that would "leave the library field strong and resilient." The draft framework identifies TASCHA, the Public Library Association (PLA), a division of the American Library Association, and the International Federation of Library Associations and Institutions (IFLA) as the expected three lead legacy partners tasked with refining the framework over the next year, and then identifying and carrying out key research and capacity building initiatives that will carry forward Global Libraries' goal of improving lives through public libraries around the world.

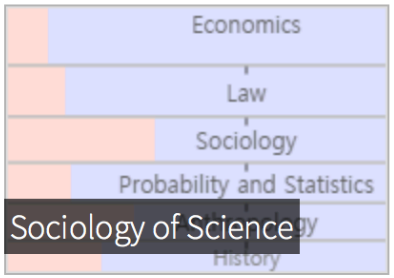
"This is exciting news for the iSchool and our entire community. The selection of TASCHA is a testament to the quality of their research and the support they have for that work in the field and in our school," said iSchool Dean



RESEARCH AREAS







NEWS

23 Nov.

JEVIN WEST ON MEGAJOURNALS IN THE *CHRONICLE OF HIGHER EDUCATION*

Jevin West discusses the rise of the megajournal and our open access cost effectiveness tool in the *Chronicle of Higher Education*.

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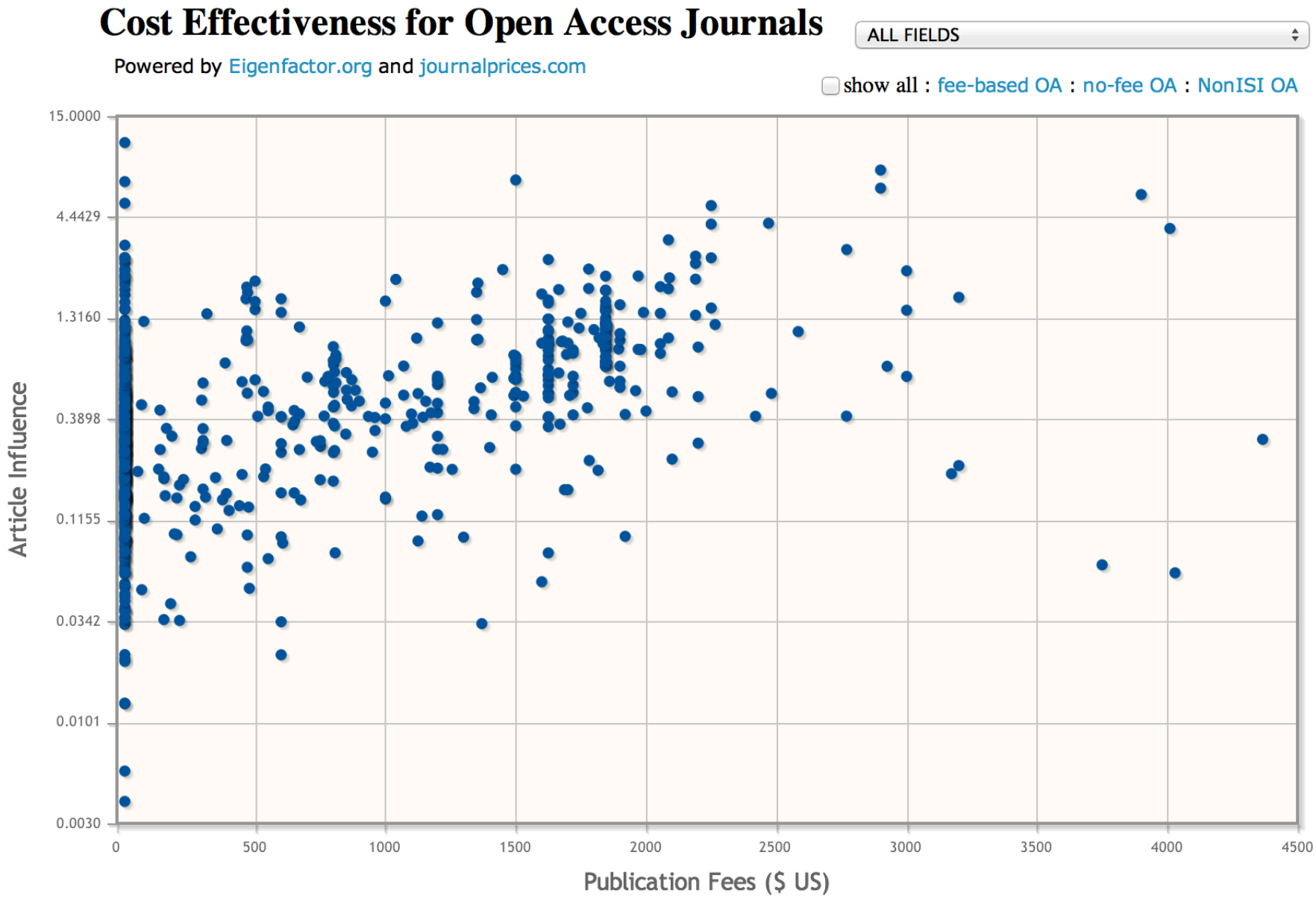
23 Nov.

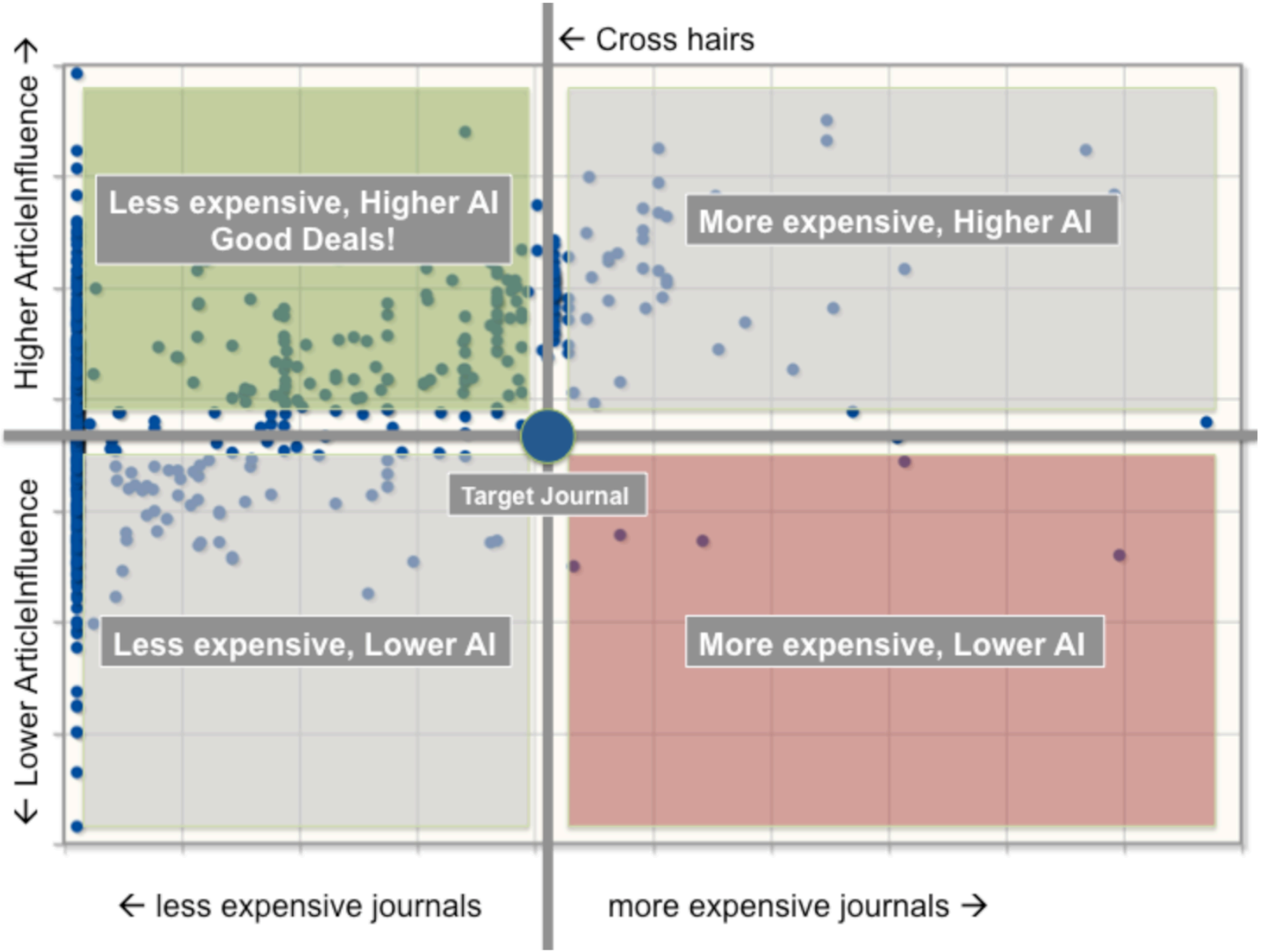
EIGENFACTOR TEAM PLACES SECOND IN MICROSOFT RESEARCH'S WSDM CUP

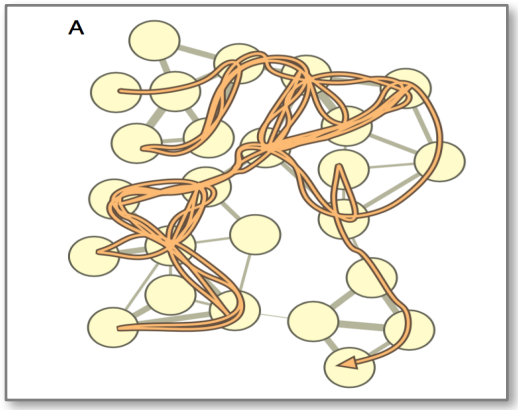
The WSDM Cup Challenge asked teams to use 30GB of data from the Microsoft Academic Graph to rank the



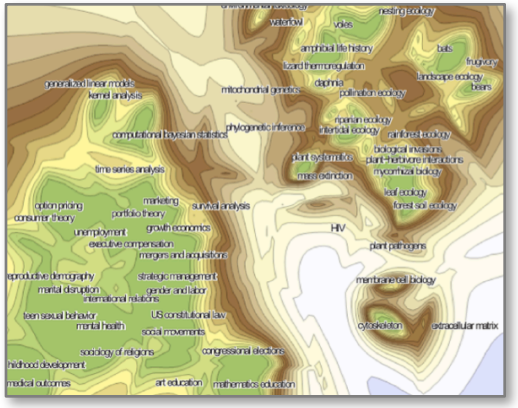
West et al. (2014) Cost-effectiveness of open access publications. *Economic Inquiry*

EIGENFACTOR – Cost Effectiveness



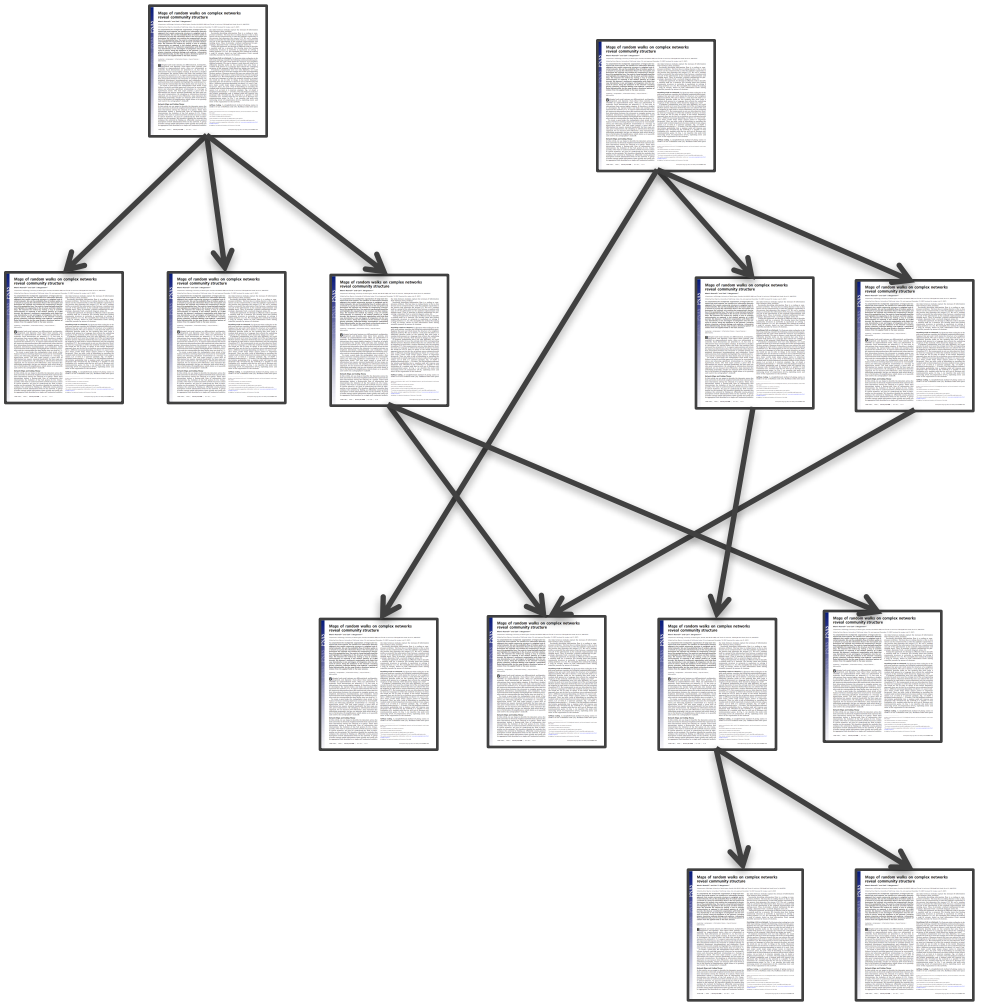


Science of Mapping



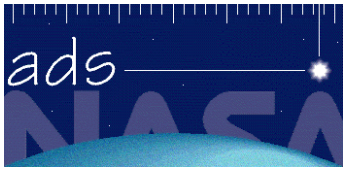
Mapping of Science

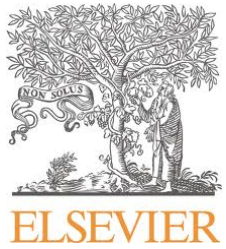
Citations form a vast network



de Solla Price, *Science* (1965)

The Scholarly Graph



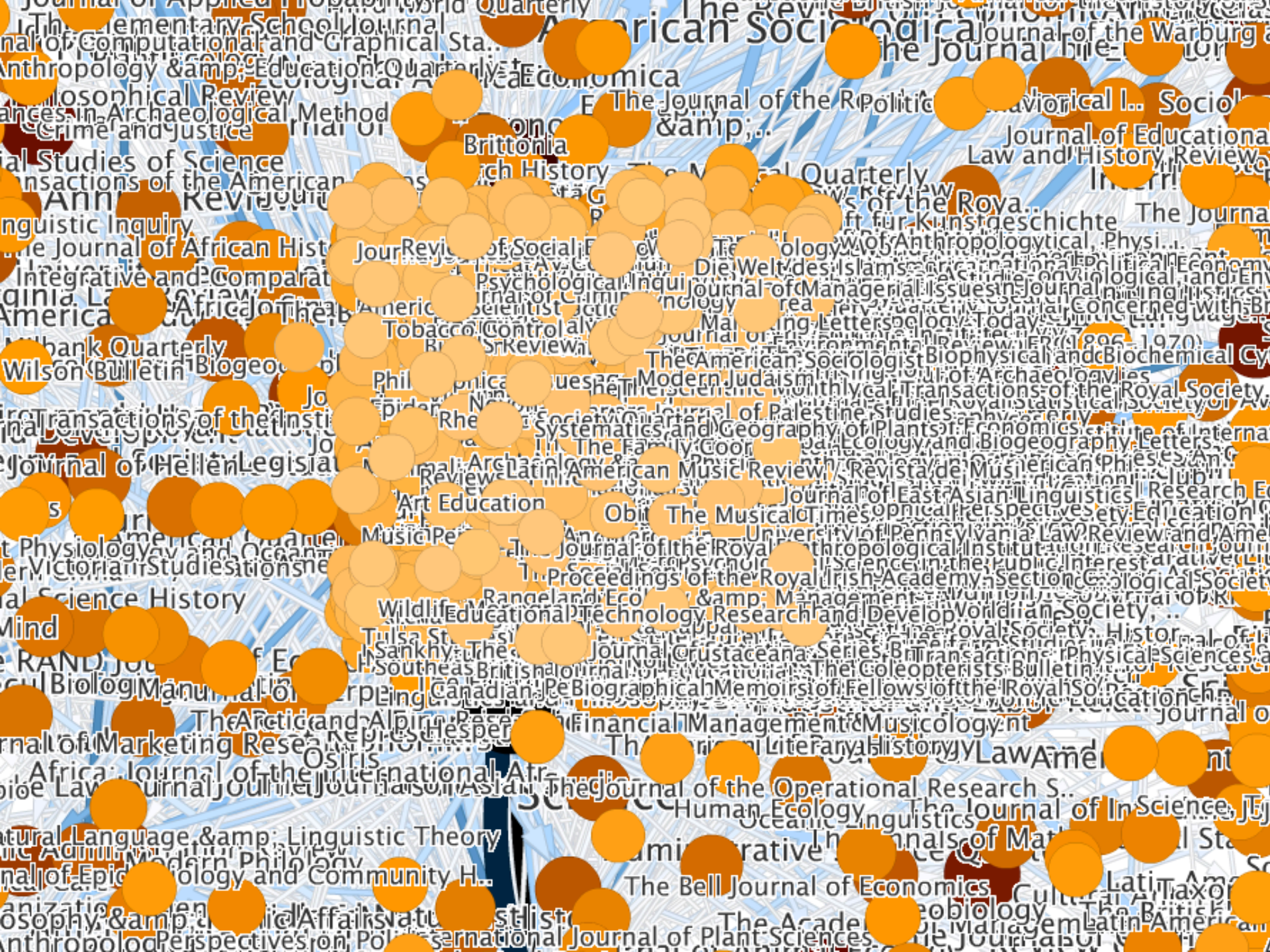


The Scholarly Graph

Tens of millions articles, patents, books

Billions of citation links

Years: 1600 - 2016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Journal of Computational and Graphical Sta..
Anthropology & Education Quarterly
Ecological Economica
The Journal of the R
Crime and Justice
Britton
Journal of Educationa
Law and History Review
Annual Review
Linguistic Inquiry
The Journal of African Hist
Integrative and Comparat
Psychological Inqui
Journal of Managerial Issues
Tobacco Control
Wilson Bulletin
The American Sociologist
Modern Judaism
Transactions of the Institu
Systematics and Geography of Plants
Journal of Hellen
Latin American Music Review, Revista de Musi
Art Education
The Musical Times
Victorian Studies
Proceedings of the Royal Irish Academy. Section C: Geological Society
Science History
Wildlife Educational Technology Research and Develop
Mind
Journal of Marketing Rese
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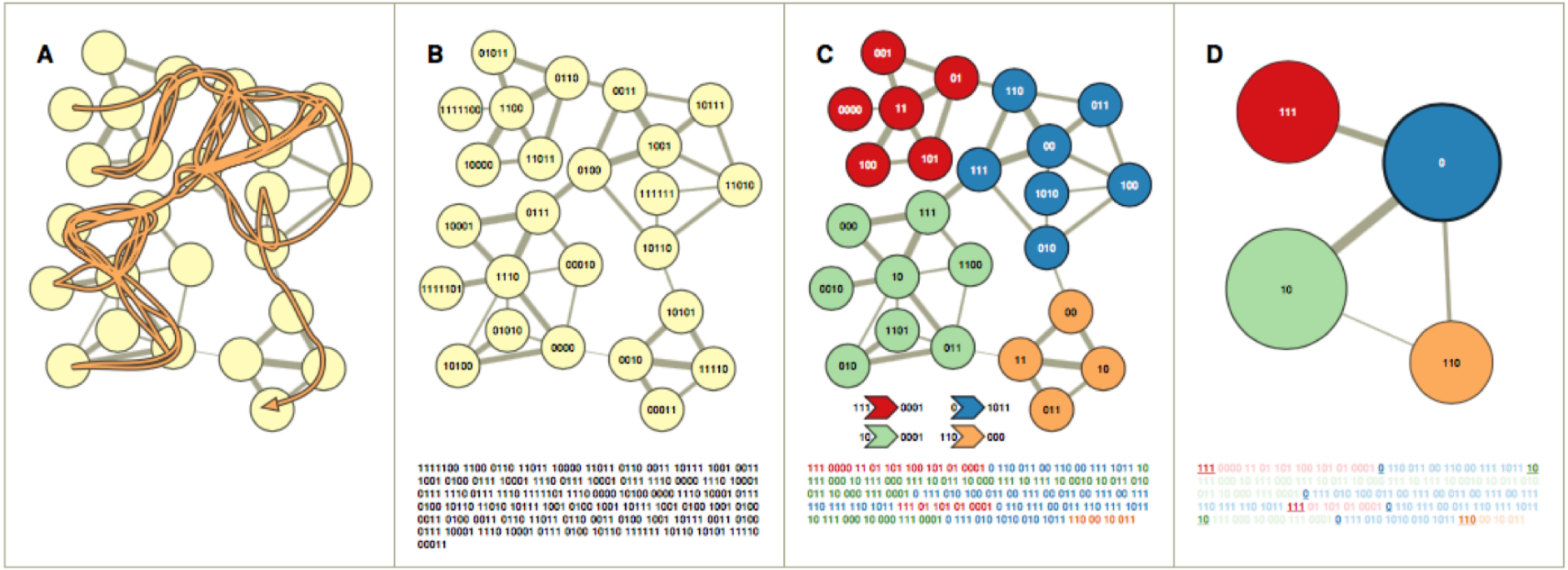
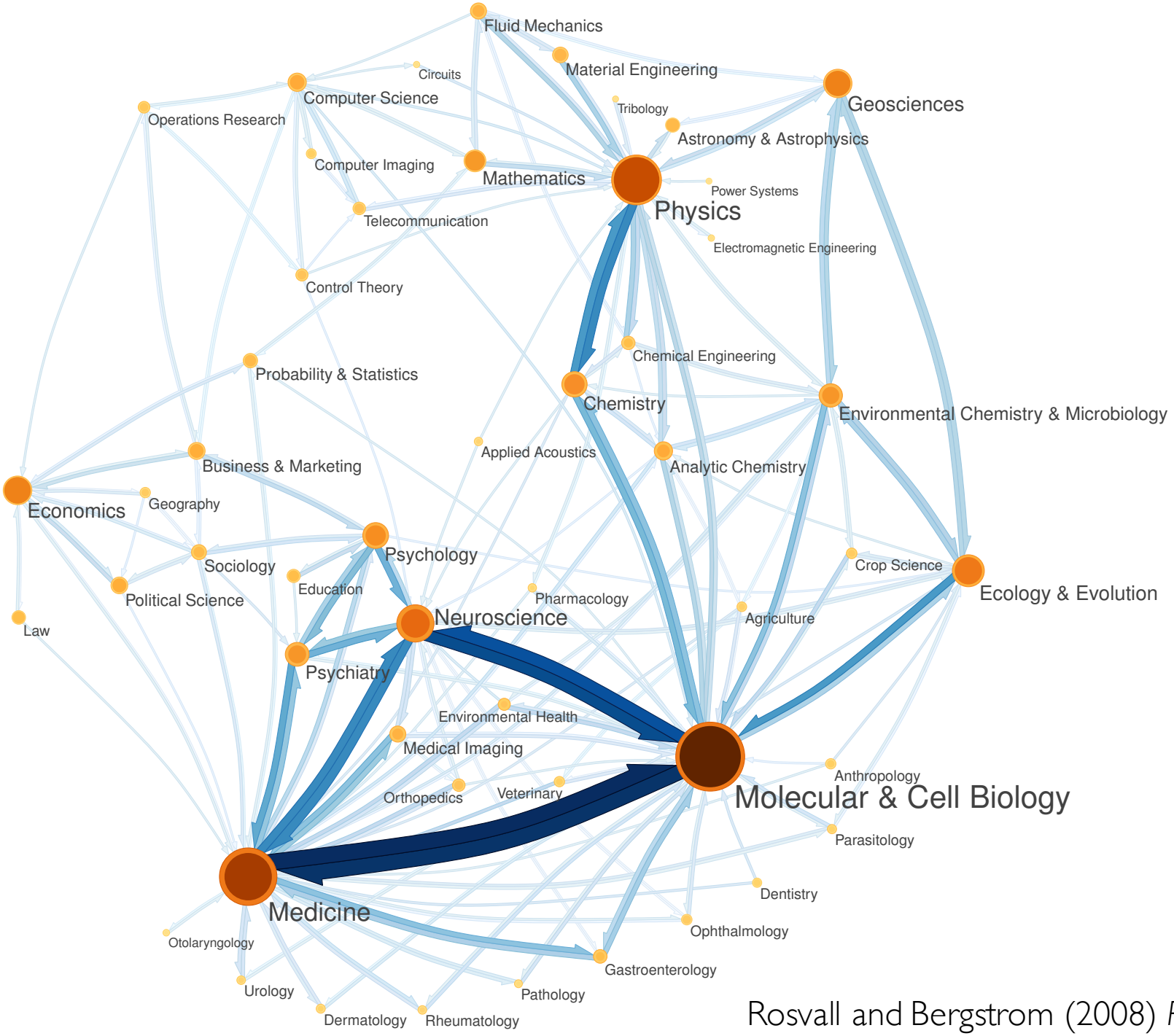
Africa: Journal of the International Af
The Journal of the Operational Research S..
Human Ecology
Natural Language & Linguistic Theory
The Bell Journal of Economics
Perspectives on Po
International Journal of Plant Sciences

Finding regularities in the dynamics on networks



Rosvall and Bergstrom (2008) PNAS



Rosvall and Bergstrom (2008) *PNAS*

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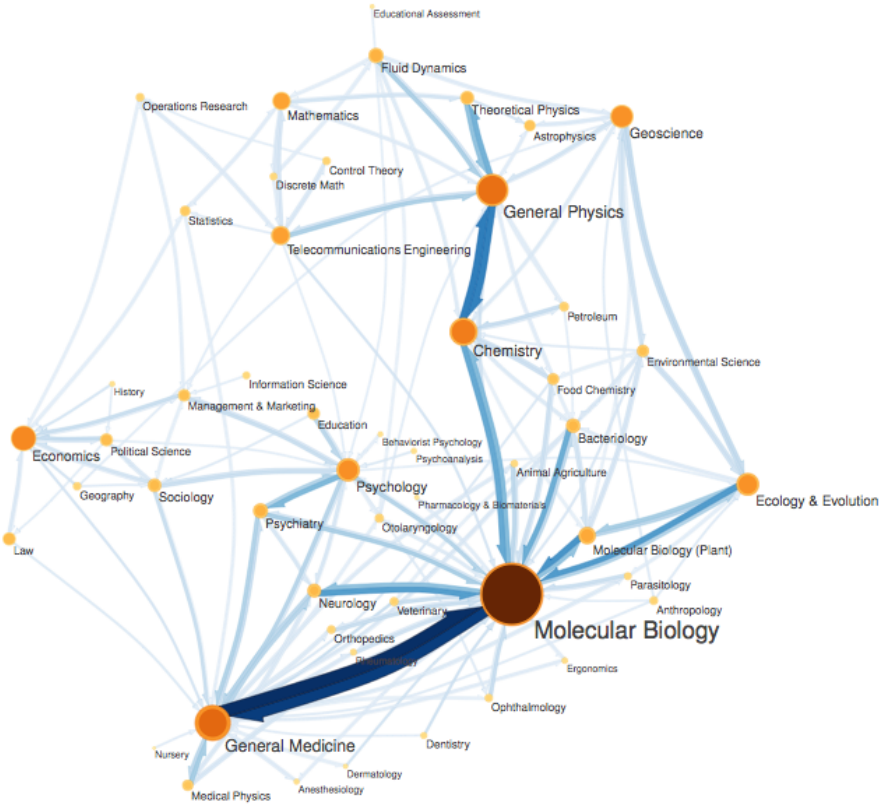
Educational Assessment
Fluid Dynamics
Operations Research
Mathematics
Theoretical Physics
Astrophysics
Geoscience
Control Theory
Discrete Math
Statistics
General Physics
Telecommunications Engineering
Petroleum
Chemistry
Environmental Science
Information Science
History
Management & Marketing
Food Chemistry
Education
Bacteriology
Economics
Political Science
Behaviorist Psychology
Psychoanalysis
Animal Agriculture
Geography
Sociology
Psychology
Ecology & Evolution
Pharmacology & Biomaterials
Psychiatry
Otolaryngology
Law
Molecular Biology (Plant)
Parasitology
Neurology
Veterinary
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Ergonomics
Ophthalmology
General Medicine
Nursery
Dentistry
Dermatology
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Anesthesiology

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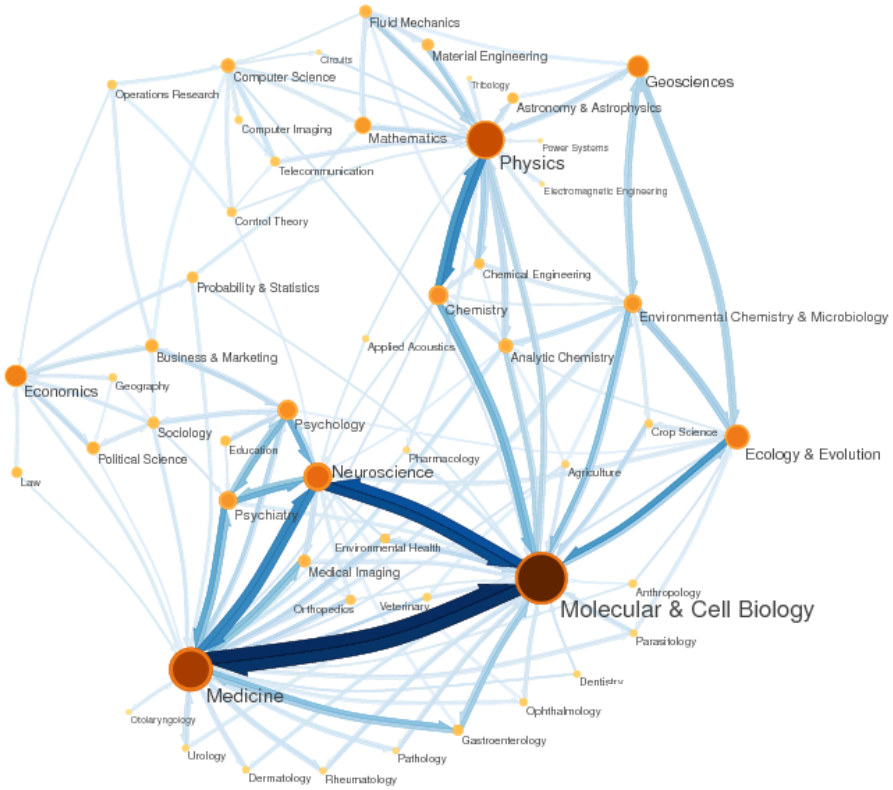
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Computer Science
Geosciences
Tribology
Operations Research
Astronomy & Astrophysics
Computer Imaging
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Physics
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Electromagnetic Engineering
Control Theory
Chemical Engineering
Probability & Statistics
Chemistry
Environmental Chemistry & Microbiology
Applied Acoustics
Business & Marketing
Analytic Chemistry
Economics
Geography
Psychology
Crop Science
Sociology
Education
Pharmacology
Ecology & Evolution
Political Science
Neuroscience
Agriculture
Law
Psychiatry
Environmental Health
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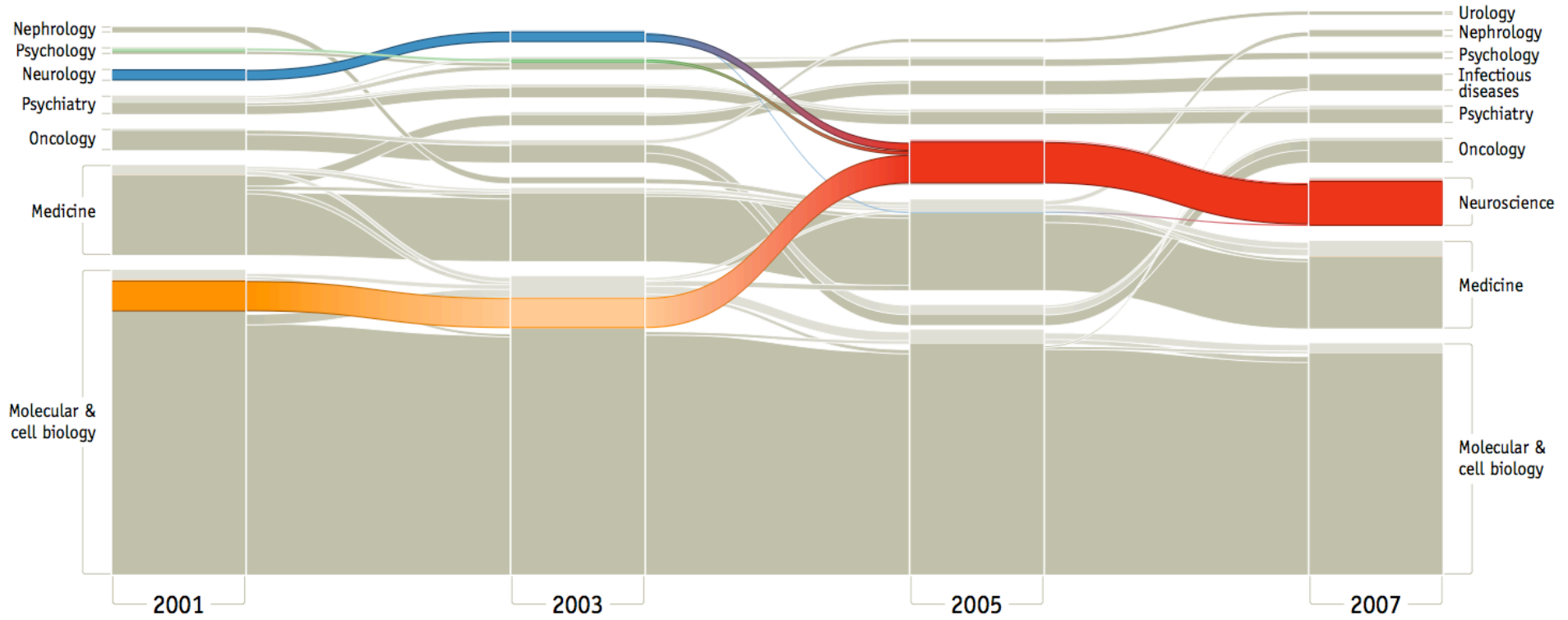
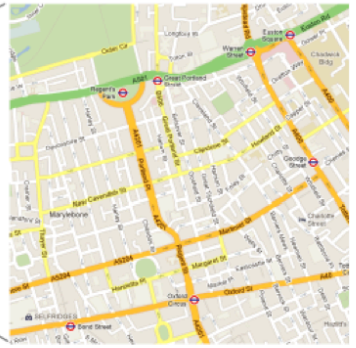
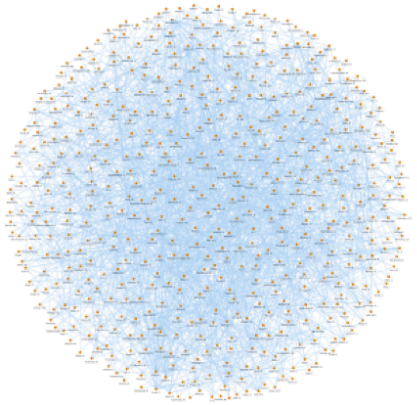
Dermatology
Rheumatology

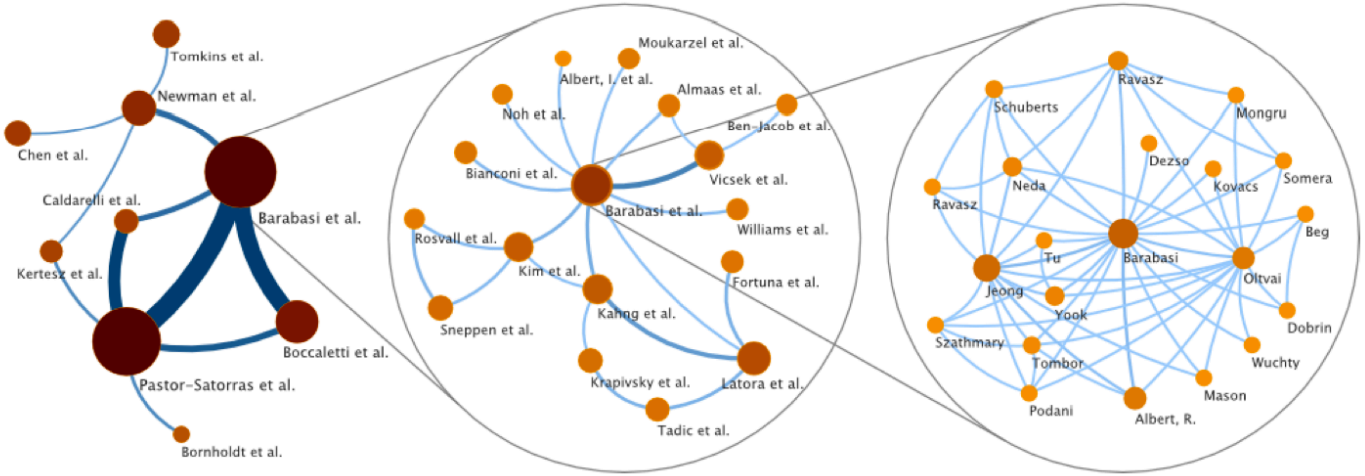
The Emergence of Neuroscience



Rosvall and Bergstrom (2010) PLoS One



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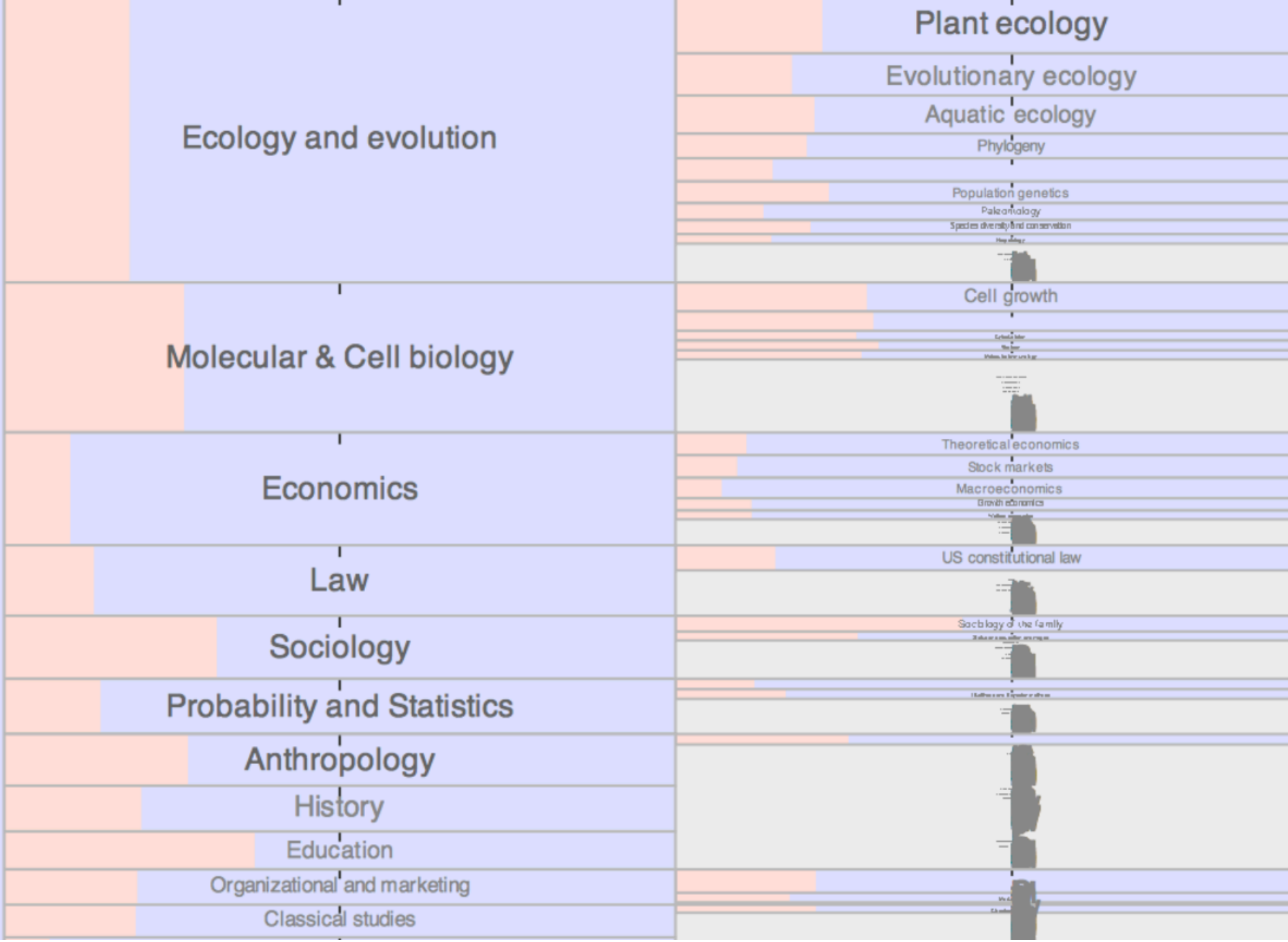
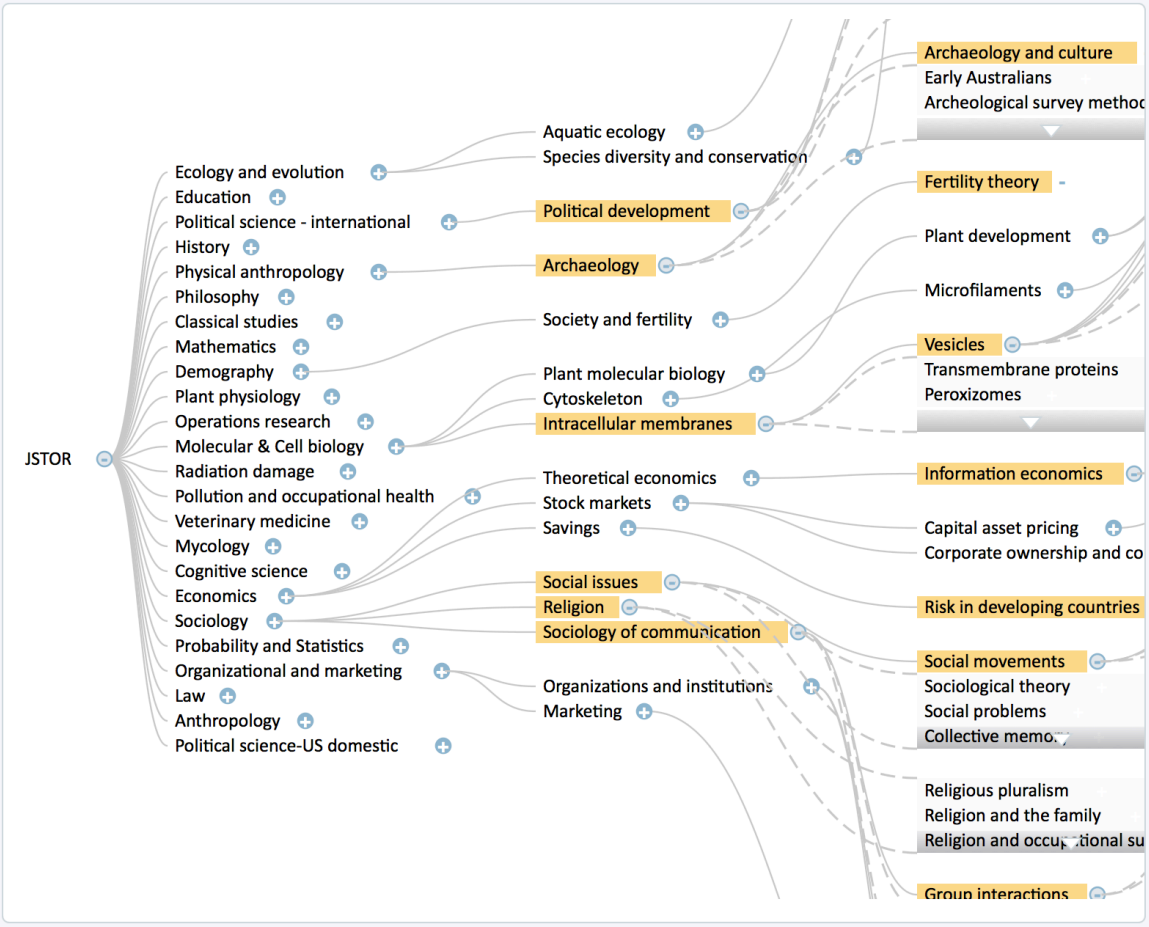


West et al. (2014) The Role of Gender in Scholarly Authorship (2013)

“Network”



Find Papers

by **title** network

by **field**

by **author**

by **journal**

Active Queries: clear all

keyword: **network**

Top Papers

Sort by Year (newest)

Using Siting Algorithms in the Design of Marine Reserve Networks
Heather Leslie - *Ecological Applications* (2003)

Mechanism of Filopodia Initiation by Reorganization of a Dendritic Network
Tatyana Svitkina - *The Journal of Cell Biology* (2003)

Network Structure and Knowledge Transfer: The Effects of Cohesion and Range
Ray Reagans - *Administrative Science Quarterly* (2003)

A General Model for Designing Networks of Marine Reserves
Enric Sala - *Science* (2002)

The Density of Social Networks and Fertility Decisions: Evidence from South Nyanza District, Kenya
Hans-Peter Kohler - *Demography* (2001)

A New Dynamin-Like Protein, ADL6, Is Involved in Trafficking from the trans-Golgi Network to the Central Vacuole in Arabidopsis
Jing Bo Jin - *The Plant Cell* (2001)

Comparing Sequenced Segments of the Tomato and Arabidopsis Genomes: Large-Scale Duplication Followed by Selective Gene Loss Creates a Network of Synteny
Hsin-Mei Ku - *Proceedings of the National Academy of Sciences of the United States of America* (2000)

A Noncooperative Model of Network Formation
Venkatesh Bala - *Econometrica* (2000)

Next Steps

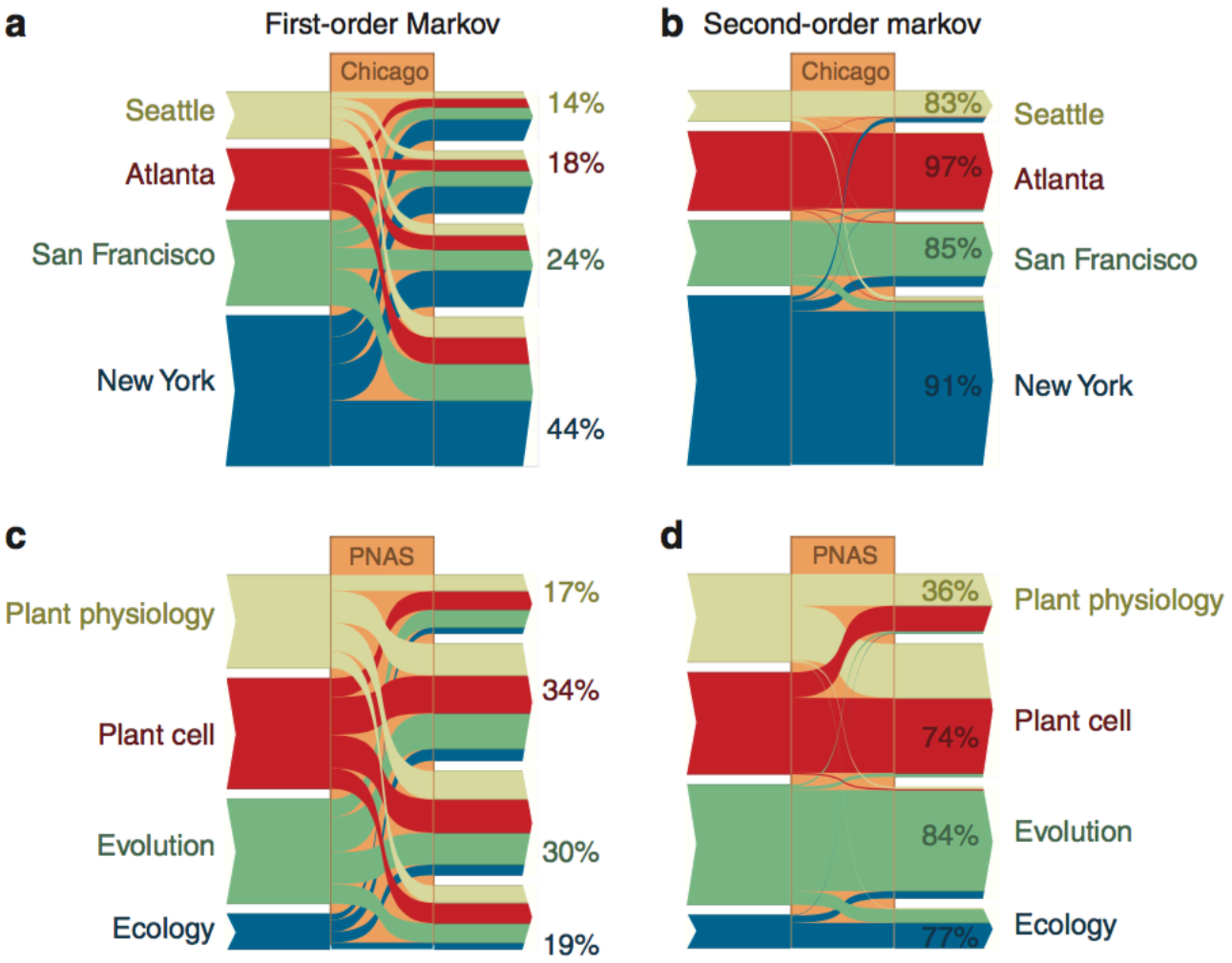
Higher Resolution Maps

Article-level Ranking

Author-centric Maps

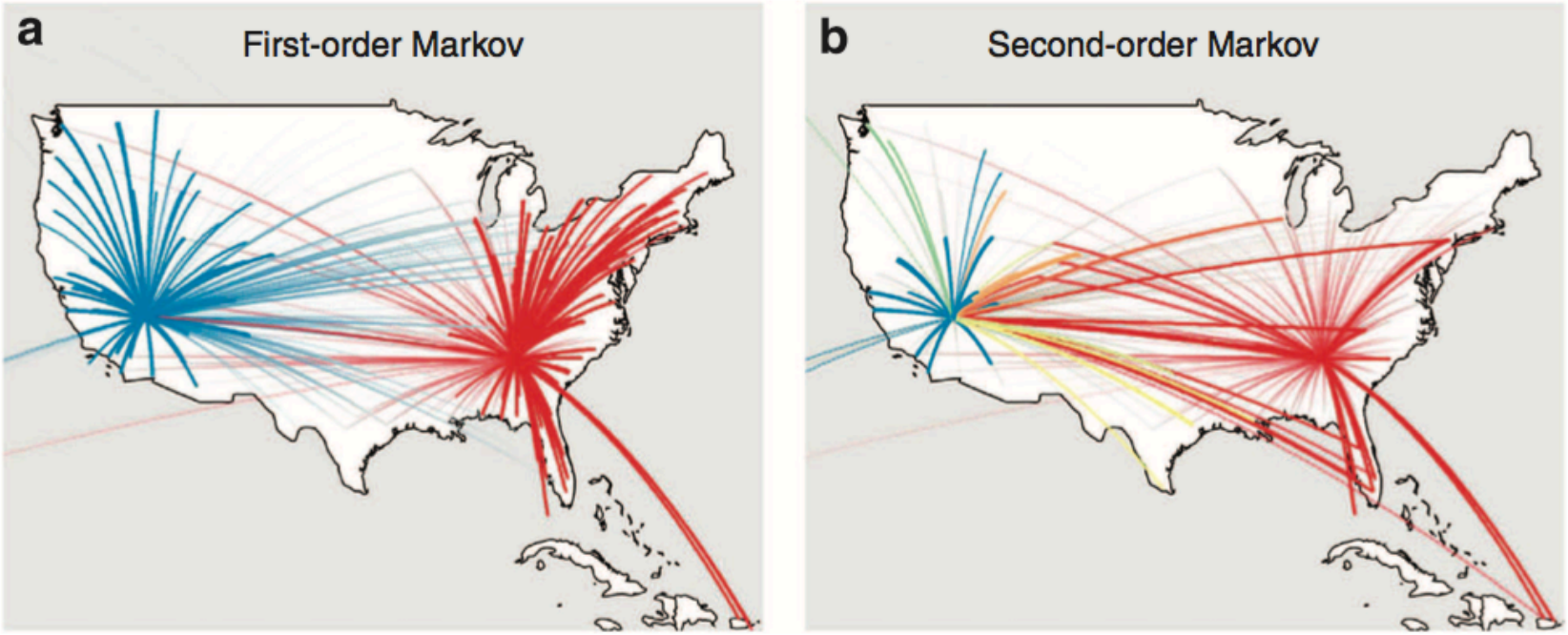
Interactive Visualizations

Higher Order Maps



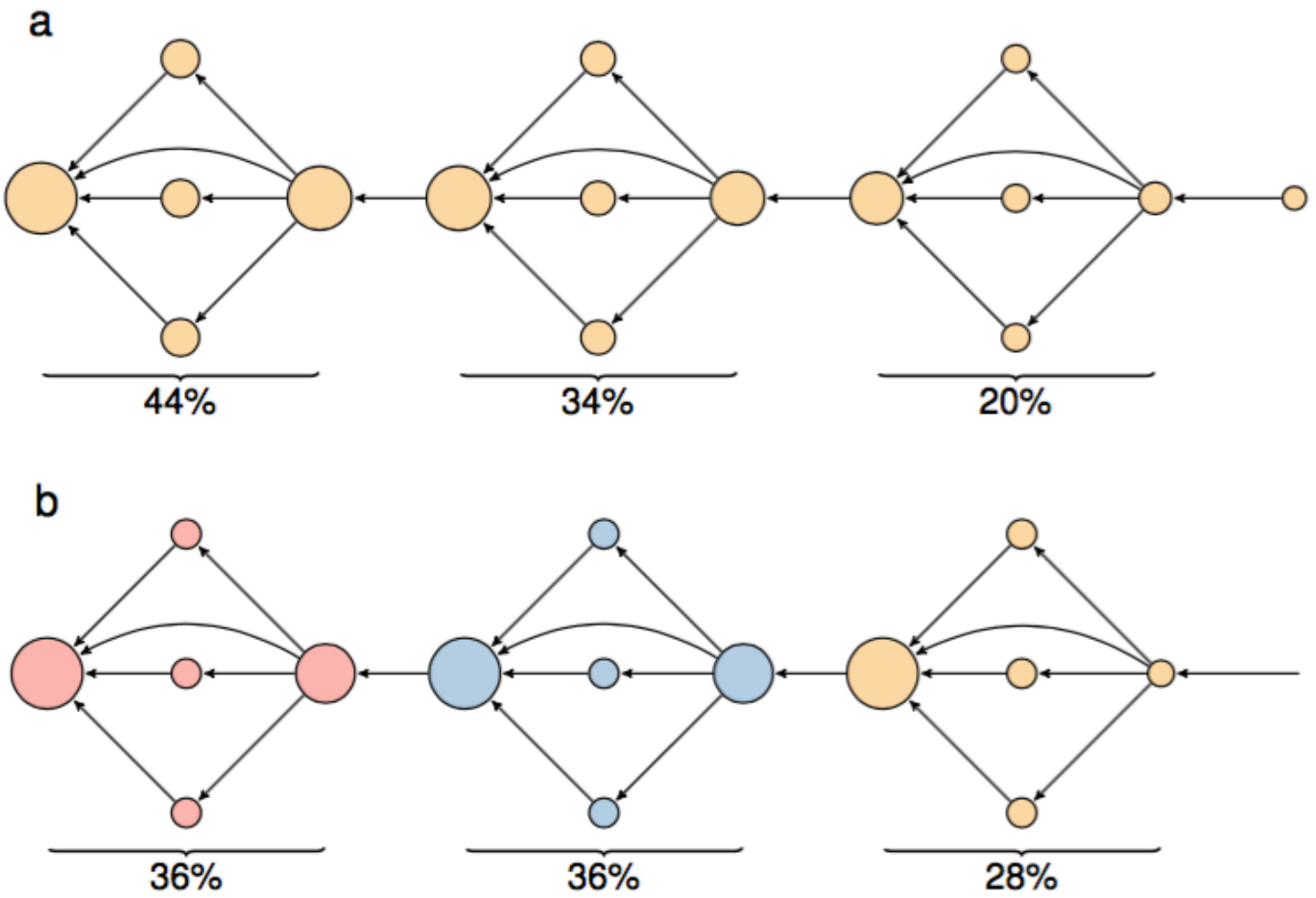
Rosvall et al. (2014) Memory in network flows and its effects on spreading dynamics and community detection. *Nature Communications*

Higher Resolution Maps



Rosvall et al. (2014) Memory in network flows and its effects on spreading dynamics and community detection. *Nature Communications*

Article-level Ranking and Mapping



West et al. (2016) Ranking and mapping article-level citation networks. *in prep.*

WSDM CUP CHALLENGE

SIGN-UPS FOR THE WSDM CUP CHALLENGE ARE NOW CLOSED

The Graph

The Microsoft Academic Graph is a heterogeneous graph containing scientific publication records, citation relationships between publications, as well as authors, institutions, journal and conference "venues," and fields of study.

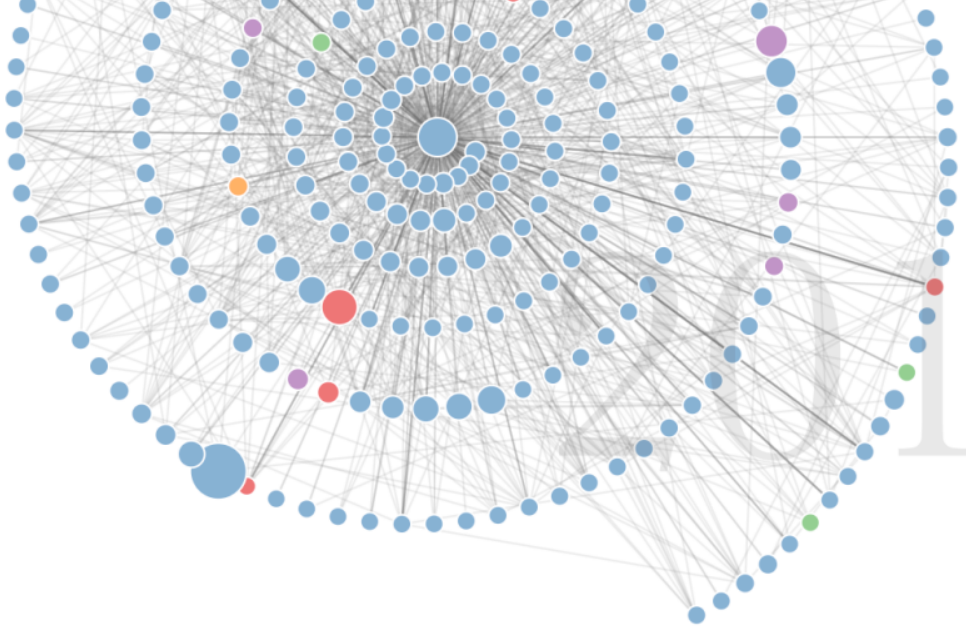
The Data

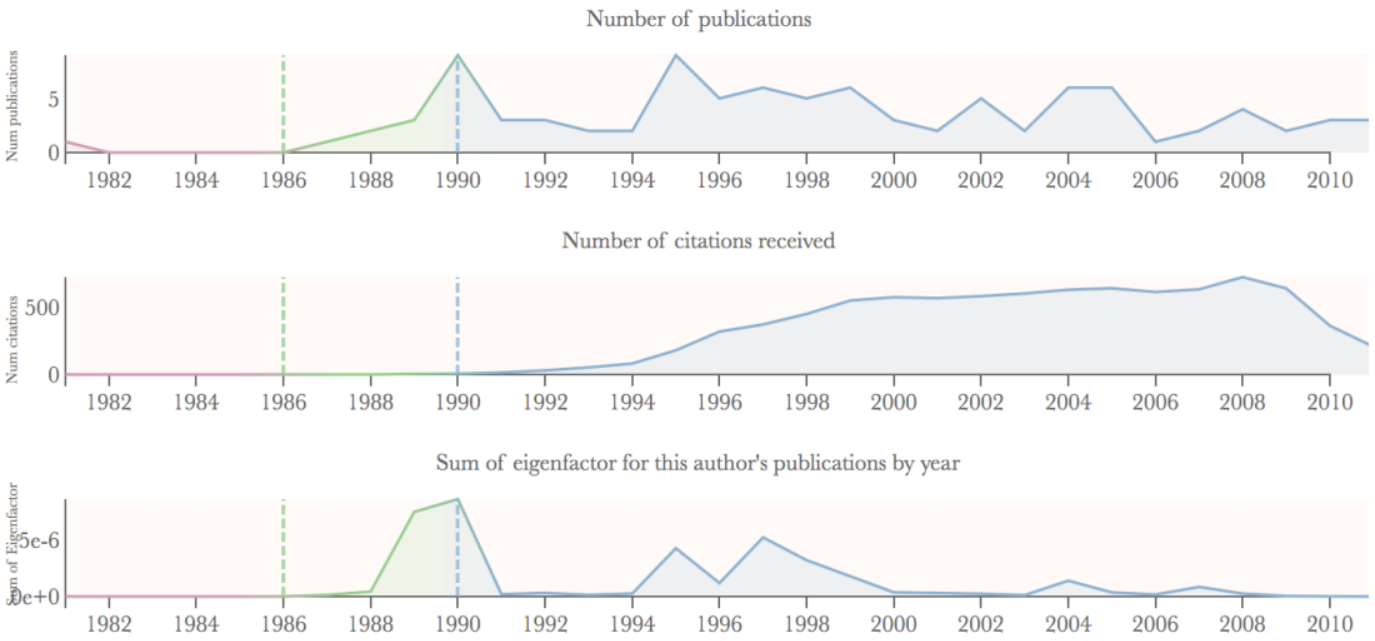
This data is available as a set of zipped text files stored in Microsoft Azure blob storage and available via HTTP. The file size (zipped) is ~30GB and may be downloaded here.

The Challenge

The goal of the Ranker Challenge is to assess the query-independent importance of scholarly articles, using data from the Microsoft Academic Graph.

Jason Portenoy





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Visualizing Scholarly Influence Over Time

Influence of Pew Scholars

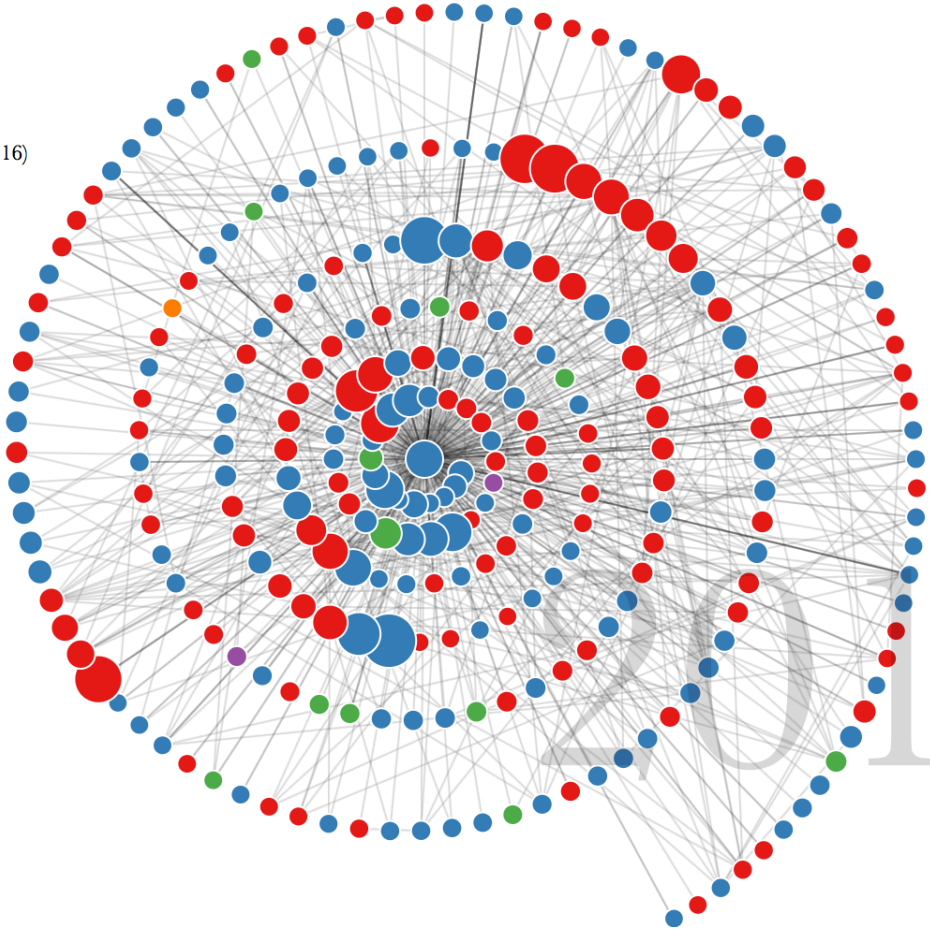
Roberta A. Gottlieb

Learn More

Papers in category "Medicine" (domain 6)
Papers in category "Biology" (domain 4)
Papers in category "Chemistry" (domain 5)
Papers in category "Unknown" (domain 0)
Papers in category "Agriculture Science" (domain 16)

Roberta A. Gottlieb

Pew Scholar
1997



Portenoy et al. (2016) Leveraging Citation Networks to Visualize Scholarly Influence Over Time. *in review*

Visualizing Scholarly Influence Over Time

Influence of Pew Scholars

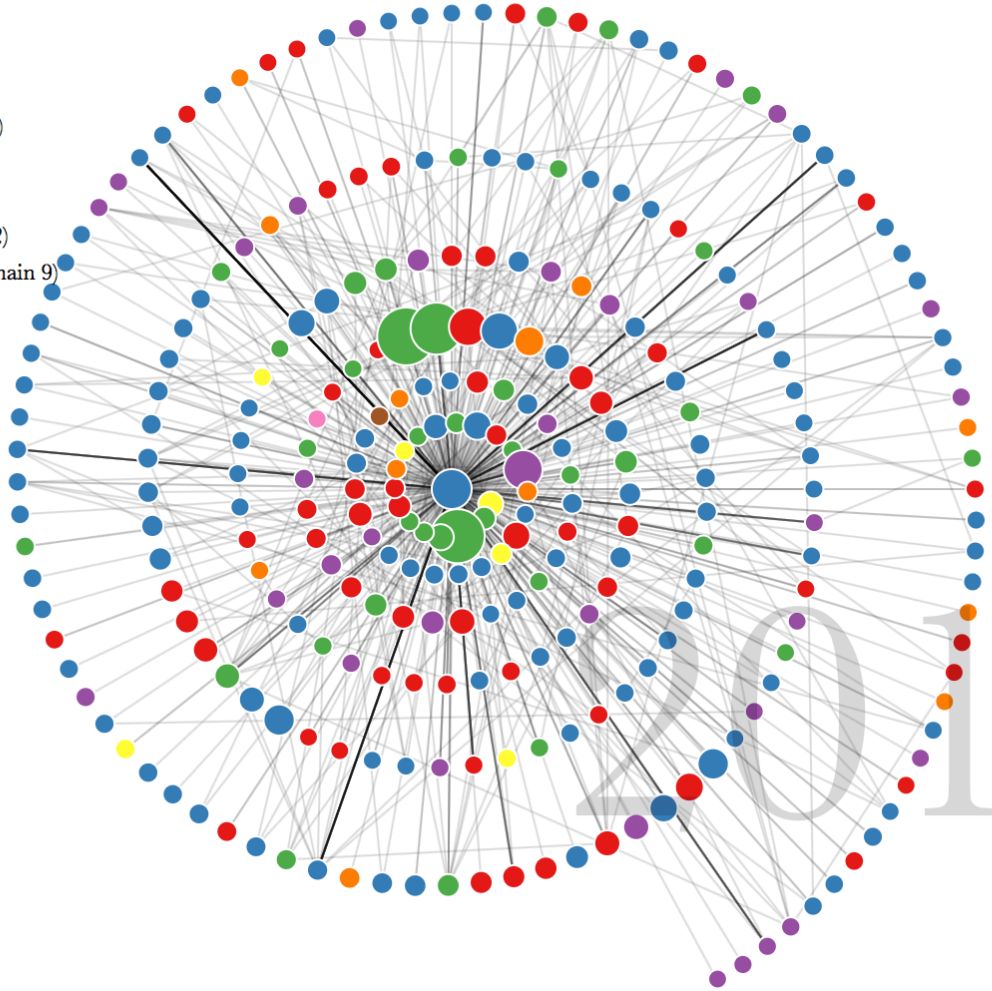
Mark W. Grinstaff

Learn More

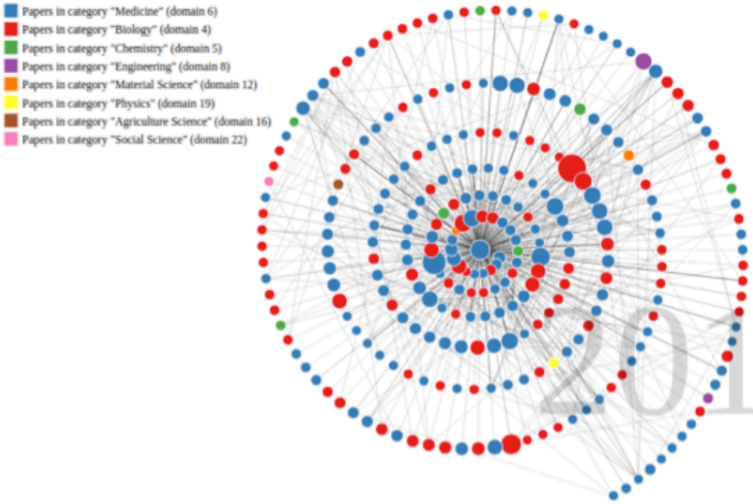
- Papers in category "Chemistry" (domain 5)
- Papers in category "Medicine" (domain 6)
- Papers in category "Biology" (domain 4)
- Papers in category "Material Science" (domain 12)
- Papers in category "Engineering" (domain 8)
- Papers in category "Physics" (domain 19)
- Papers in category "Computer Science" (domain 2)
- Papers in category "Environmental Sciences" (domain 9)

Mark W.
Grinstaff

Pew Scholar
1999

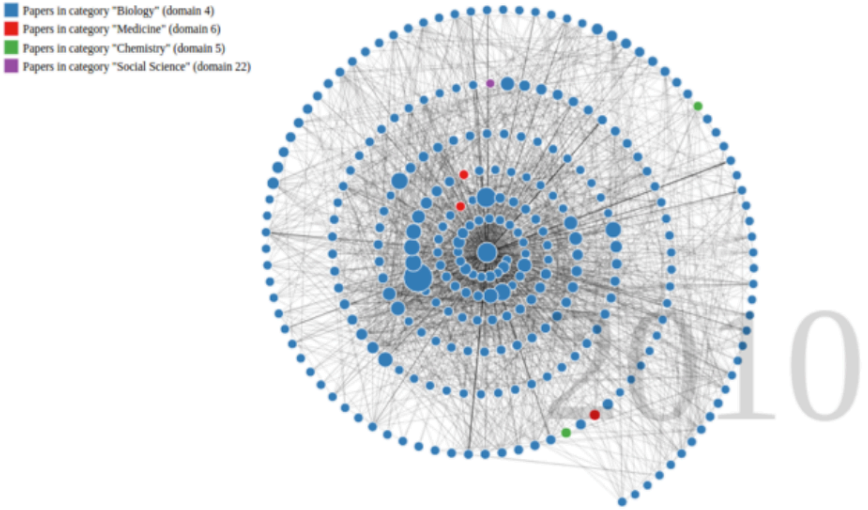


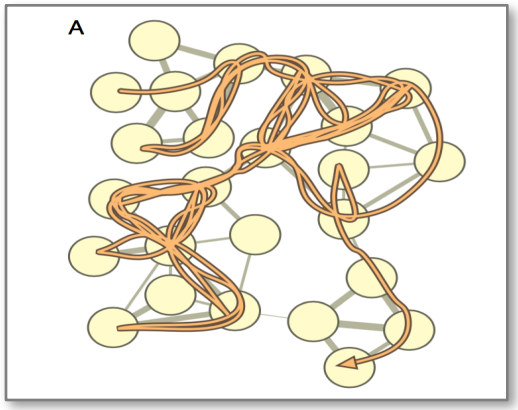
Comparing Authors



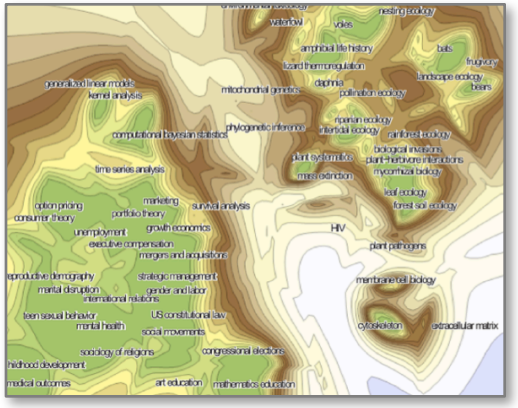
A more sparse network indicates fewer citations between papers shown in the network. This could be a result of the central scholar having impact across a wider set of academic communities.

A denser network means that the papers that cite the central author also tend to cite each other.





Science of Mapping

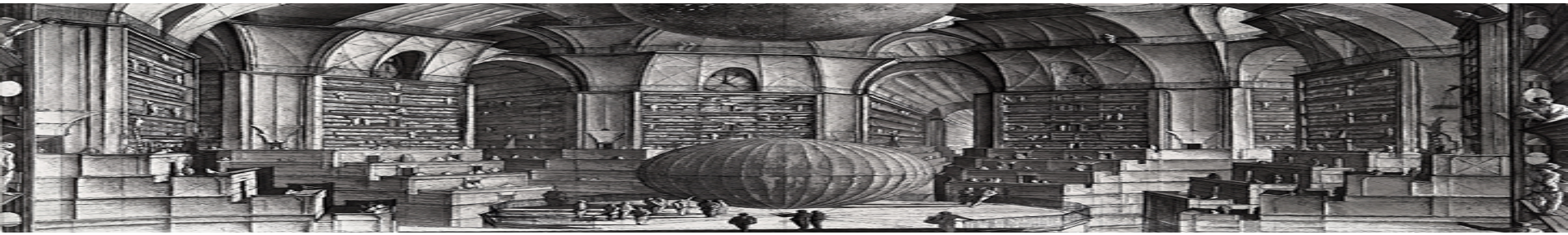


Mapping of Science

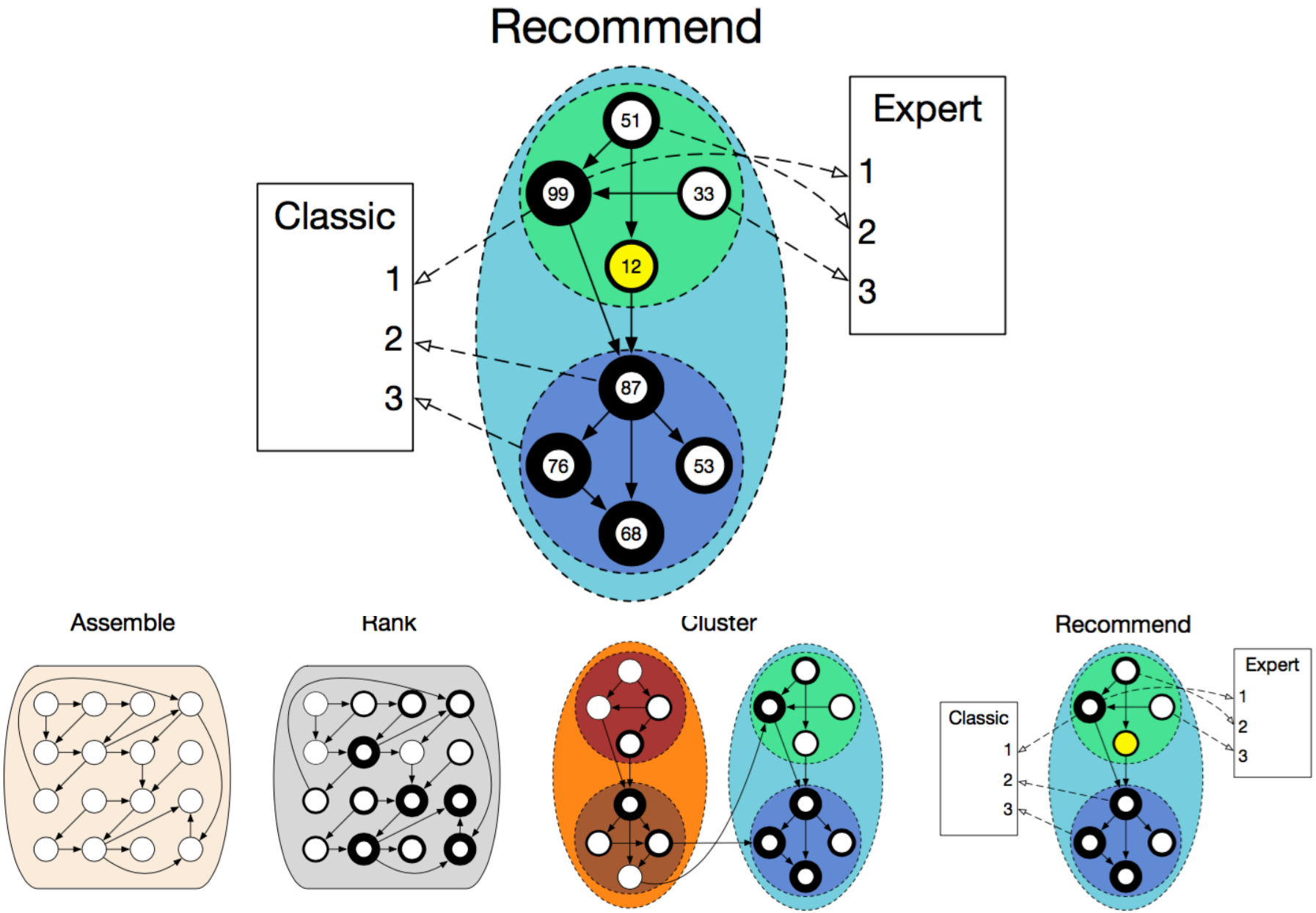
JW

Explore the recommendations

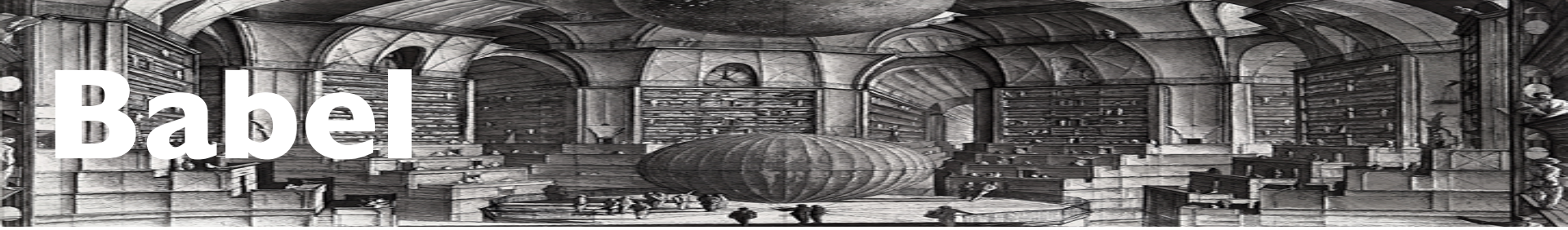
babel.eigenfactor.org



jevinw@uw.edu



West, Wesley-Smith, Bergstrom (2016) A recommendation system based on hierarchical clustering of an article-level citation network. *IEEE Transactions on Big Data*



Babel

- Facilitate research and *implementation* of recommendations
- Bibliographic data at scale
- Freely available and open source
- Evaluation of recommendations
- Audience: publishers, researchers, developers
- API Standardization & Endpoint Discovery

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JSTOR Sustainability BETA

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Search

CONSERVATION BIOLOGY OVERVIEW

Conservation is the scientific study of the nature and of Earth's biodiversity with the aim of protecting species, their habitats, and ecosystems from excessive rates of extinction and the erosion of biotic interactions. It is an interdisciplinary subject drawing on natural and social sciences, and the practice of natural resource management.The conservation ethic is based on the findings of conservation biology.

Source: Wikipedia

Source: Wikimedia Commons

Influential Articles

1960s | 1970s | 1980s | 1990s | 2000s | 2010s | 2020

- The Canonical Distribution of Commonness and ...
- An Equilibrium Theory of Insular Zoogeography
- Turnover Rates in Insular Biogeography: ...
- The Statistics and Biology of the ...

Related Topics

Species

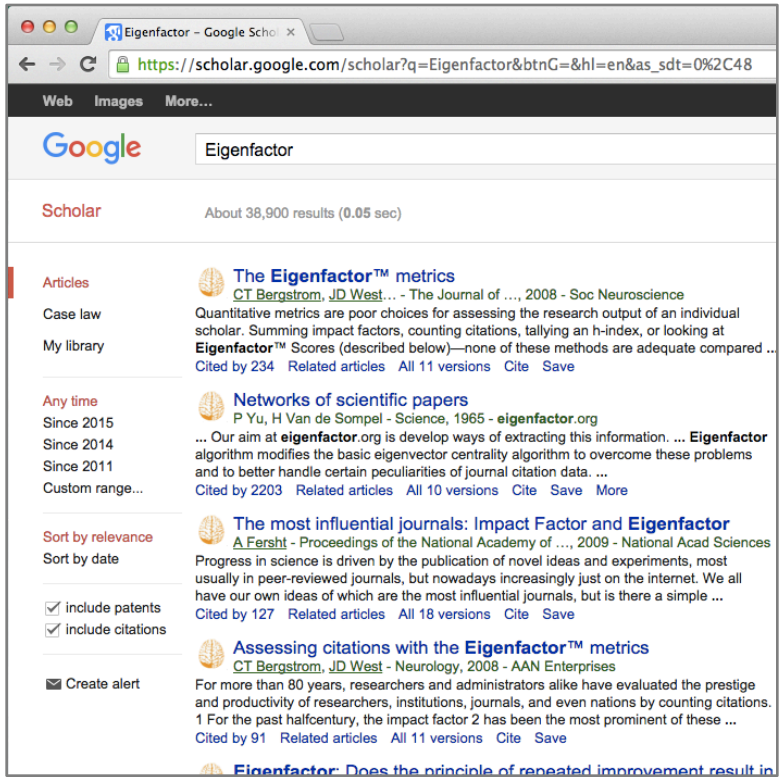
Habitat conservation

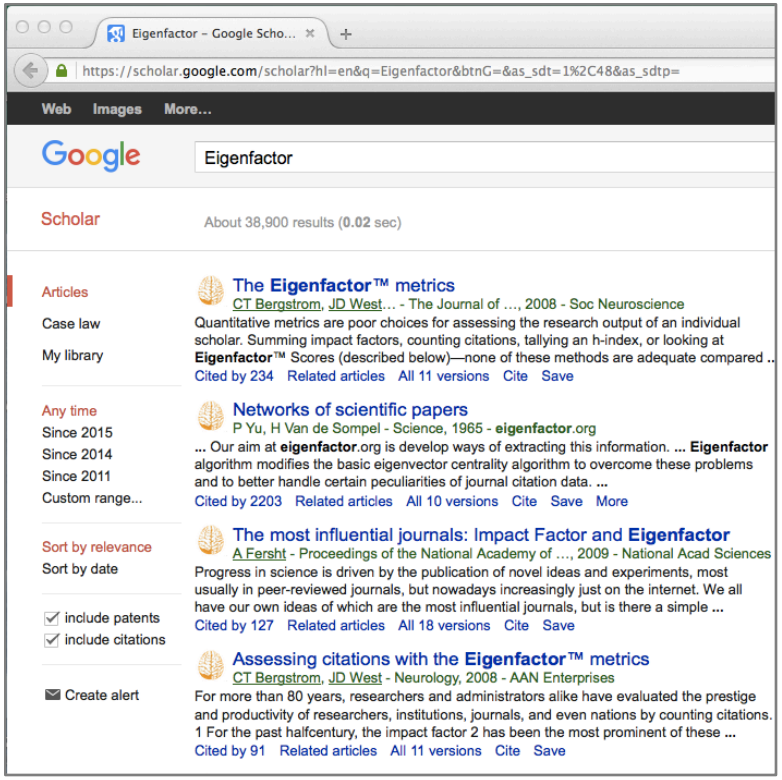
http://labs.jstor.org/sustainability/topic/Biodiversity

Browser Plugins

Firefox

chrome

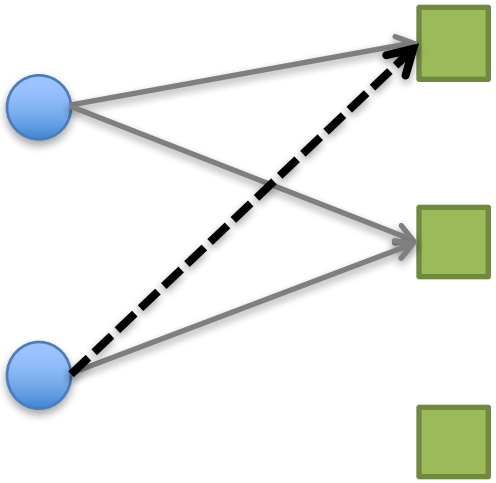




JW

A-B Testing

Usage-based

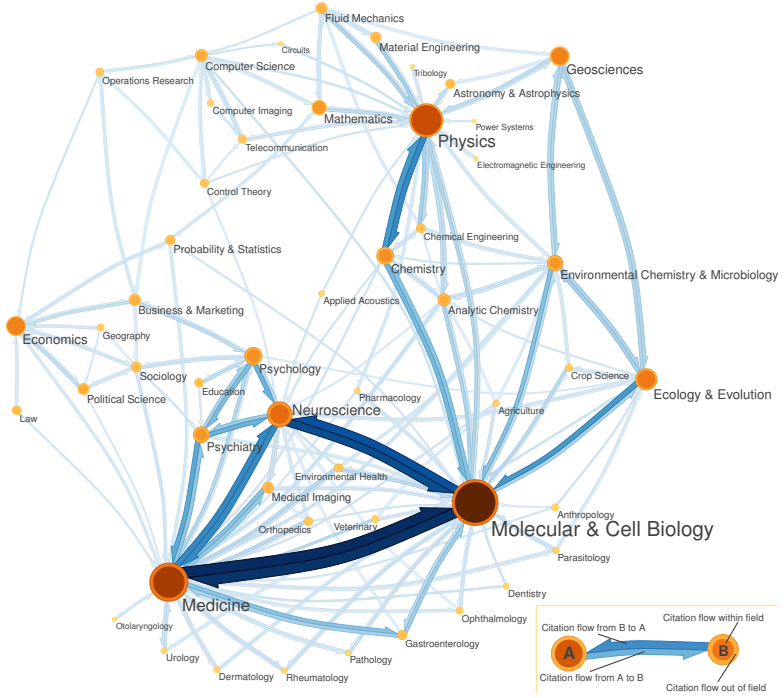


People

Papers

Utilizes download paper of similar readers

Citation-based

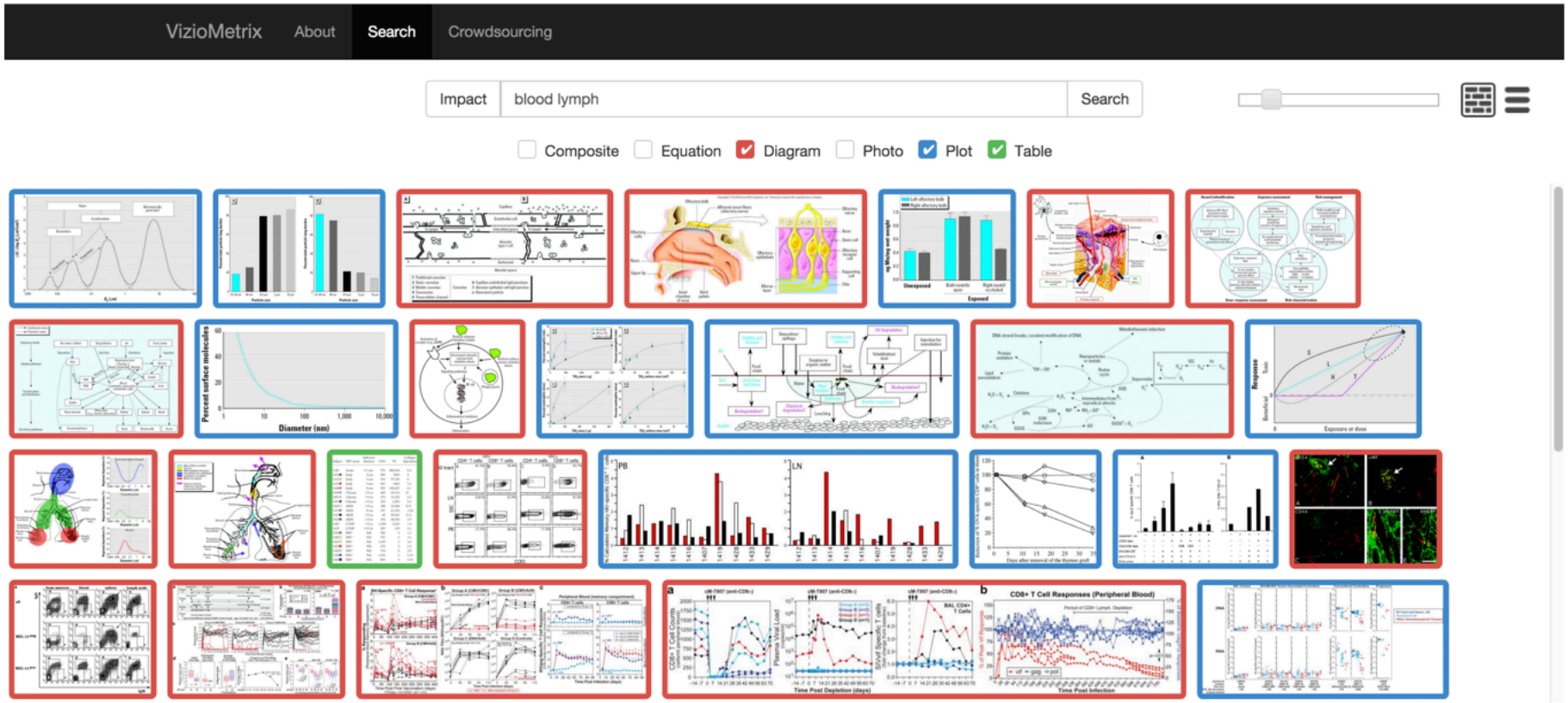


Utilizes hierarchical structure of citation graph and the relative position of papers

I. Wesley-Smith, R. Dandrea, J.D. West (2015) An Experimental Platform for Scholarly Article recommendation. *Information Retrieval (BIR2015)*

Figure-Centric Search Engine

viziometrics.org



Questions

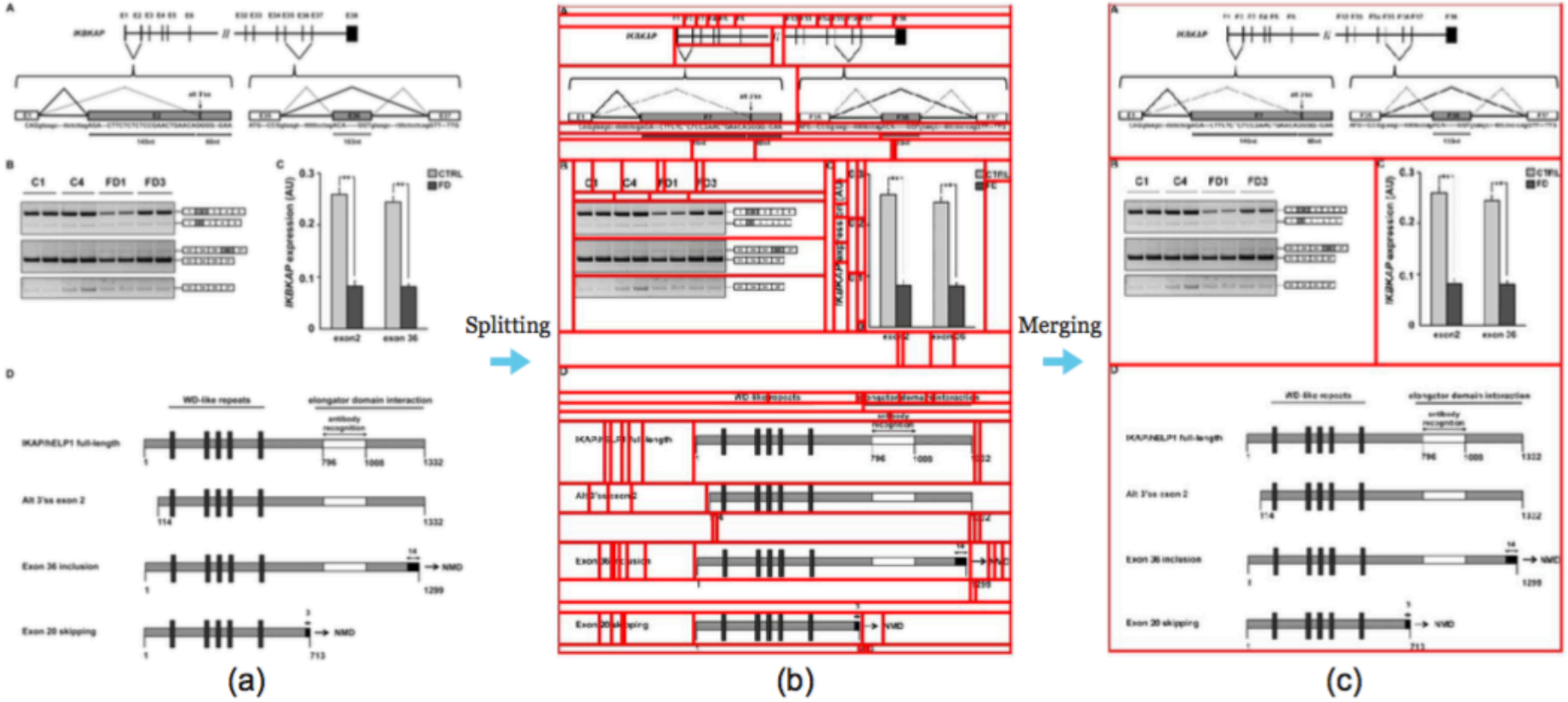
- How do patterns of encoding visual information in the literature vary across disciplines?
- How have patterns of encoding visual information in the literature evolved over time?
- Is there any link between patterns of encoding visual information and scientific impact?

How can we better utilize visual information in the search and navigation process?

650,000 papers

5 million figures

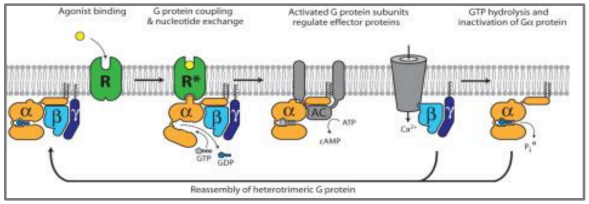
Composite Figure Dismantling



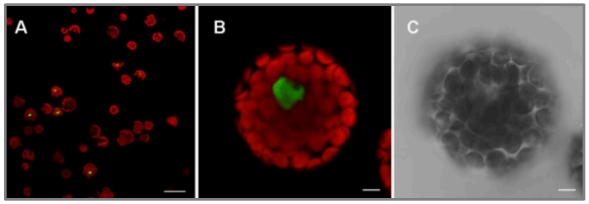
Lee et al (2015)

$$w_i = \sum_j^n (Z_{ij} + Z_{ij}^T)$$

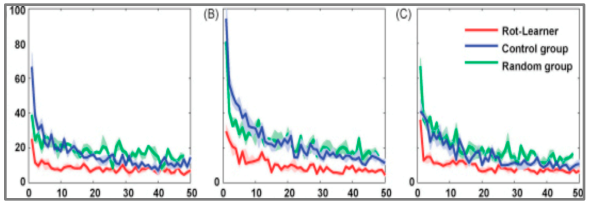
Equations (394)



Schematics (769)



Photos (782)

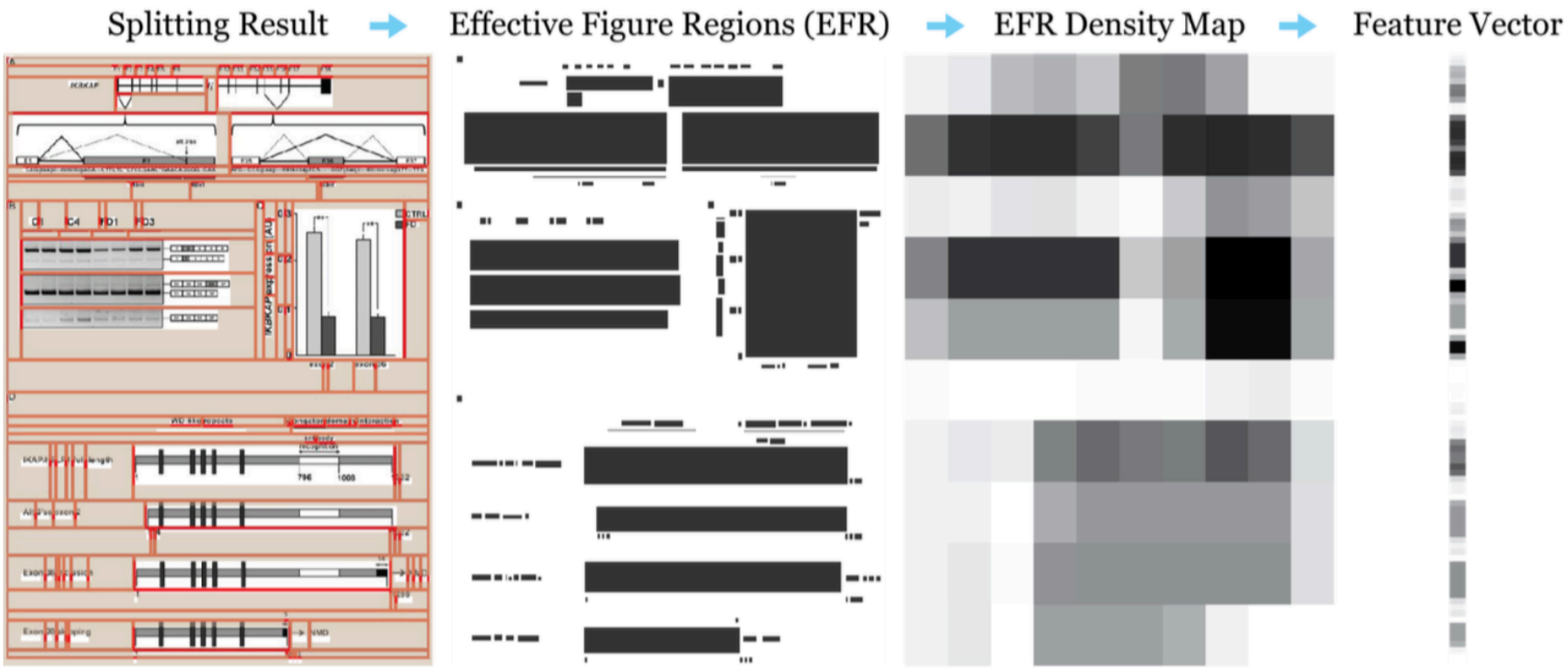


Plots (890)

	PW reading	PW reading	PW reading	W reading	W reading
	W RT	*PW RT*	*CTL*	*W RT*	*PW RT*
MOG → LOT	0.28	0.18	***0.58***	***−0.70***	***−0.50***
MOG → LP	−0.22	***−0.52***	−0.04	0.27	−0.03
LOT → LP	0	0.10	0.24	***−0.56***	***−0.60***
LOT → IFG	0.38	0.17	0.40	0.43	0.13
LP → IFG	0.26	0.05	0.31	0.03	−0.03

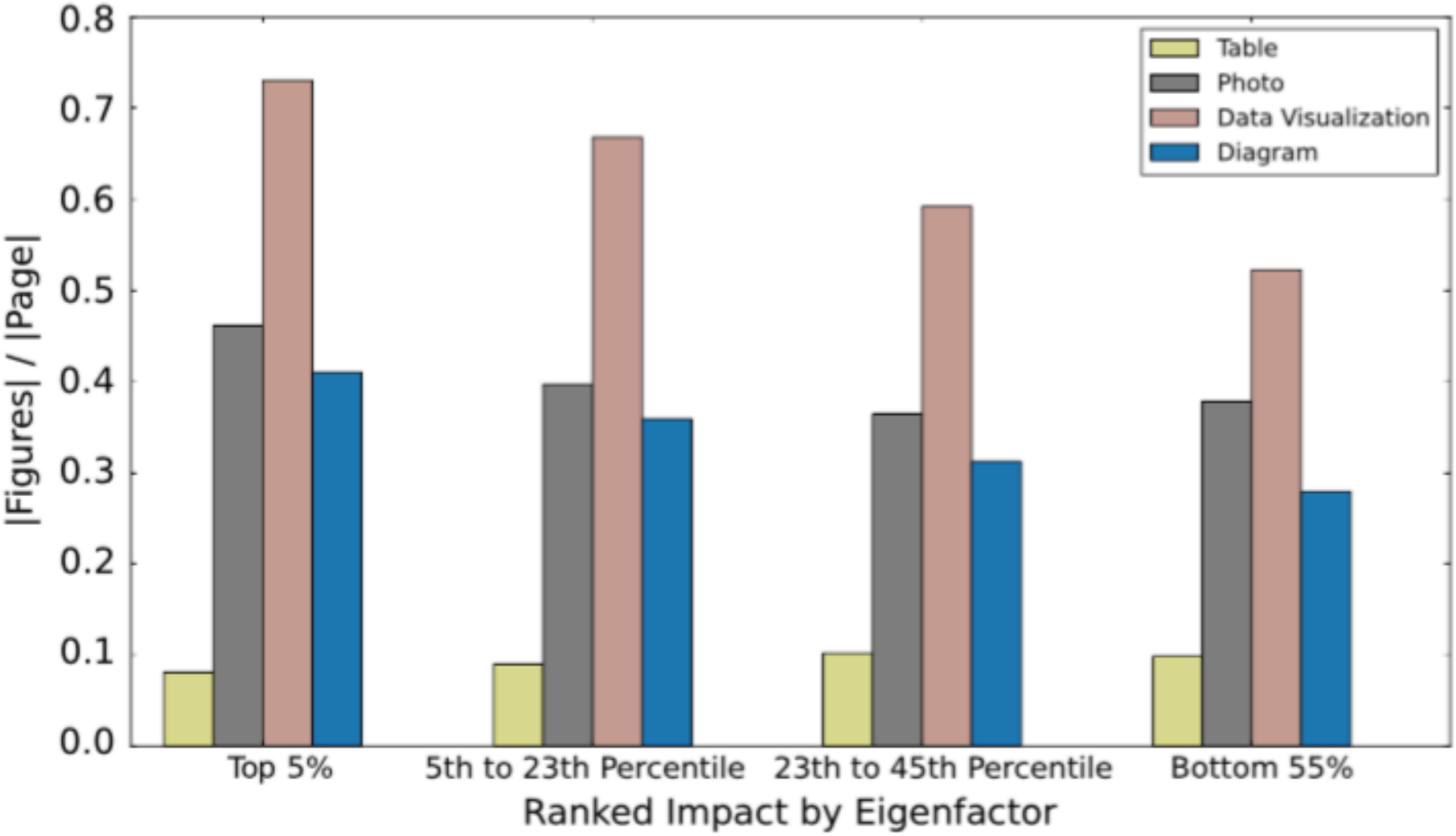
Tables (436)

Feature Extraction



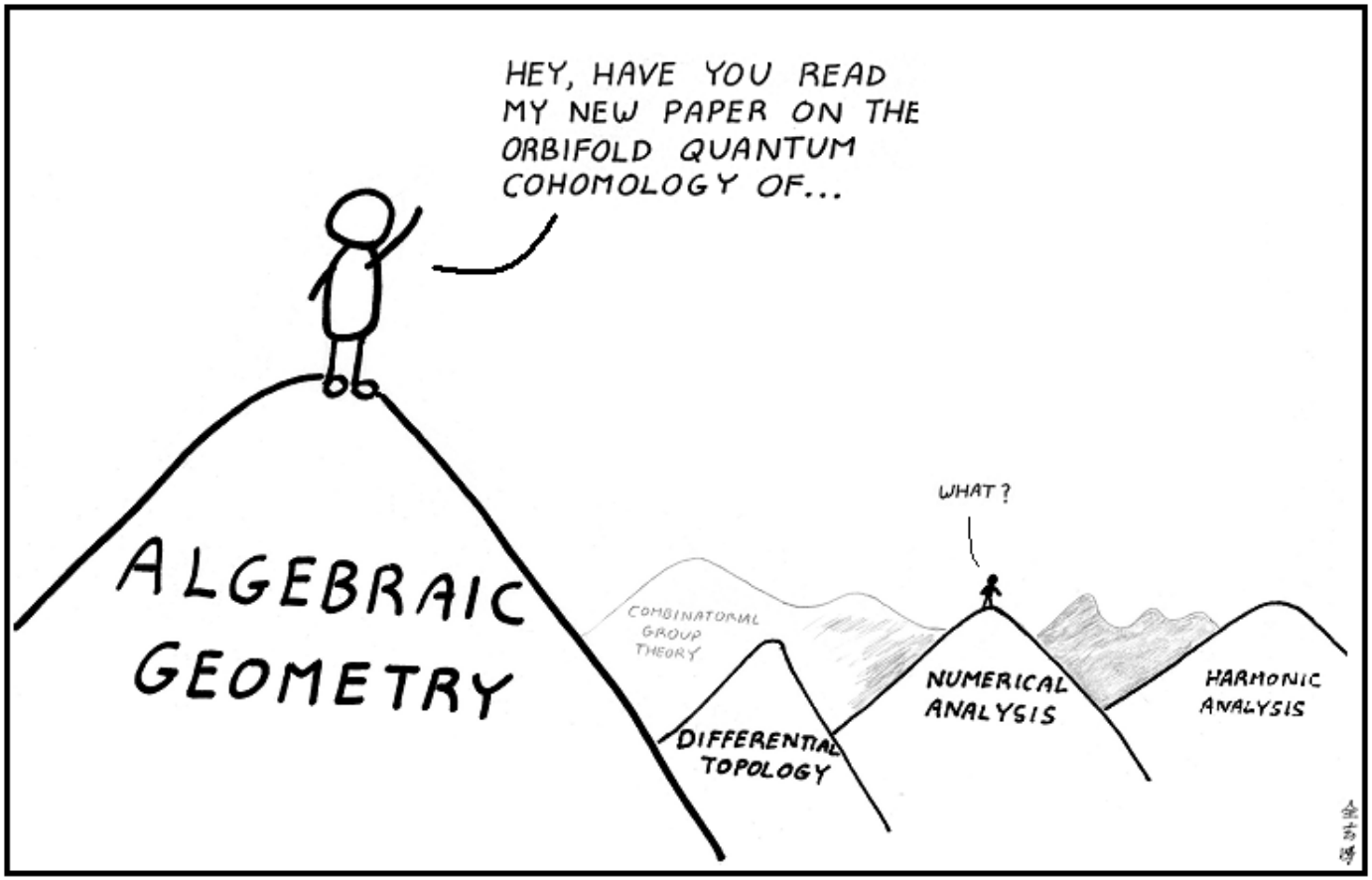
Lee et al . (2016) Viziometrics: Analyzing Visual Information in the Scientific Literature. https://www.arxiv.org/pdf/1605.04951.pdf

Impact versus Figure Density

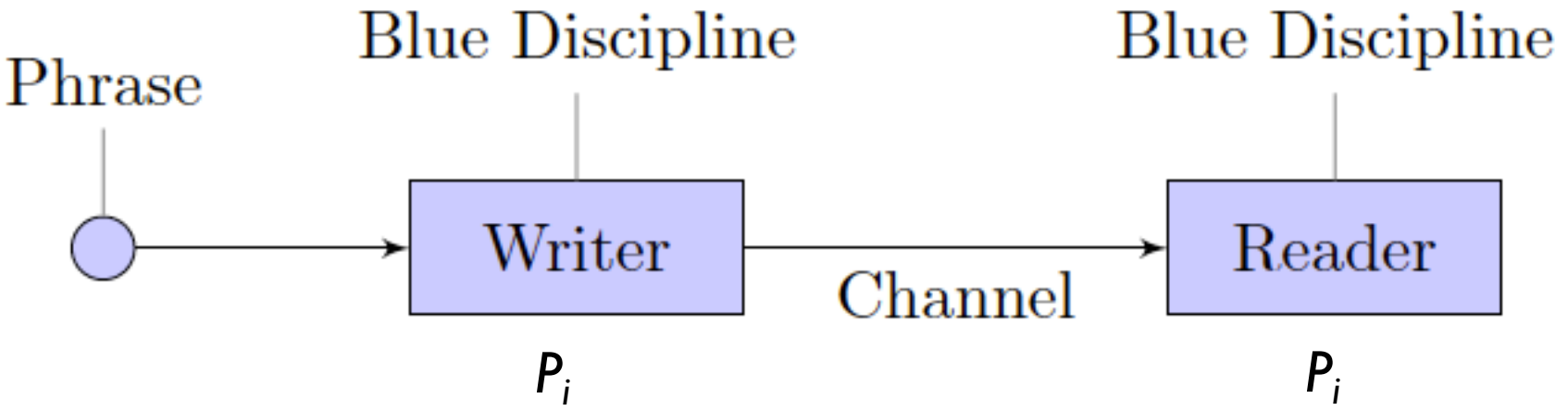


Lee et al . (2016) Viziometrics: Analyzing Visual Information in the Scientific Literature. https://www.arxiv.org/pdf/1605.04951.pdf

The jargon barriers of science



The Landscape of Modern Mathematics



$\boldsymbol{X}$ ~ space of all phrases

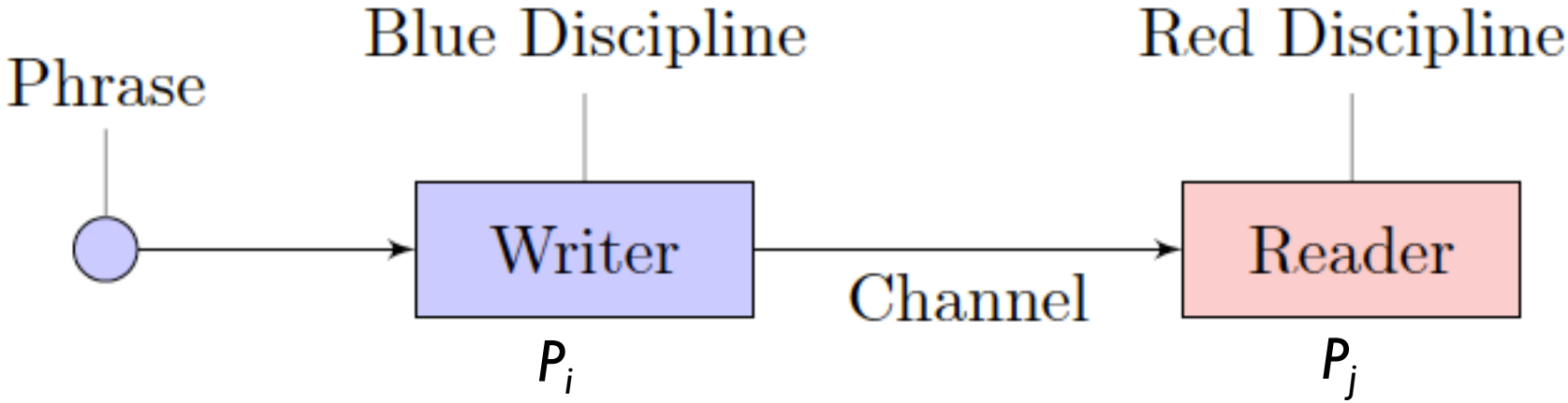
P_i ~ probability distribution over χ_i with values $x \in \boldsymbol{X}$

- writer chooses phrases with probability $p_i(x)$
- optimal codeword has length $-\log_2 p_i(x)$

expected message length $H(X_i) = -\sum_{x \in \mathcal{X}} p_i(x) \log_2 p_i(x)$

assumption: language of each scientific field is *optimized* based on frequency of phrases

Vilhena (2014) Sociological Science



cross entropy

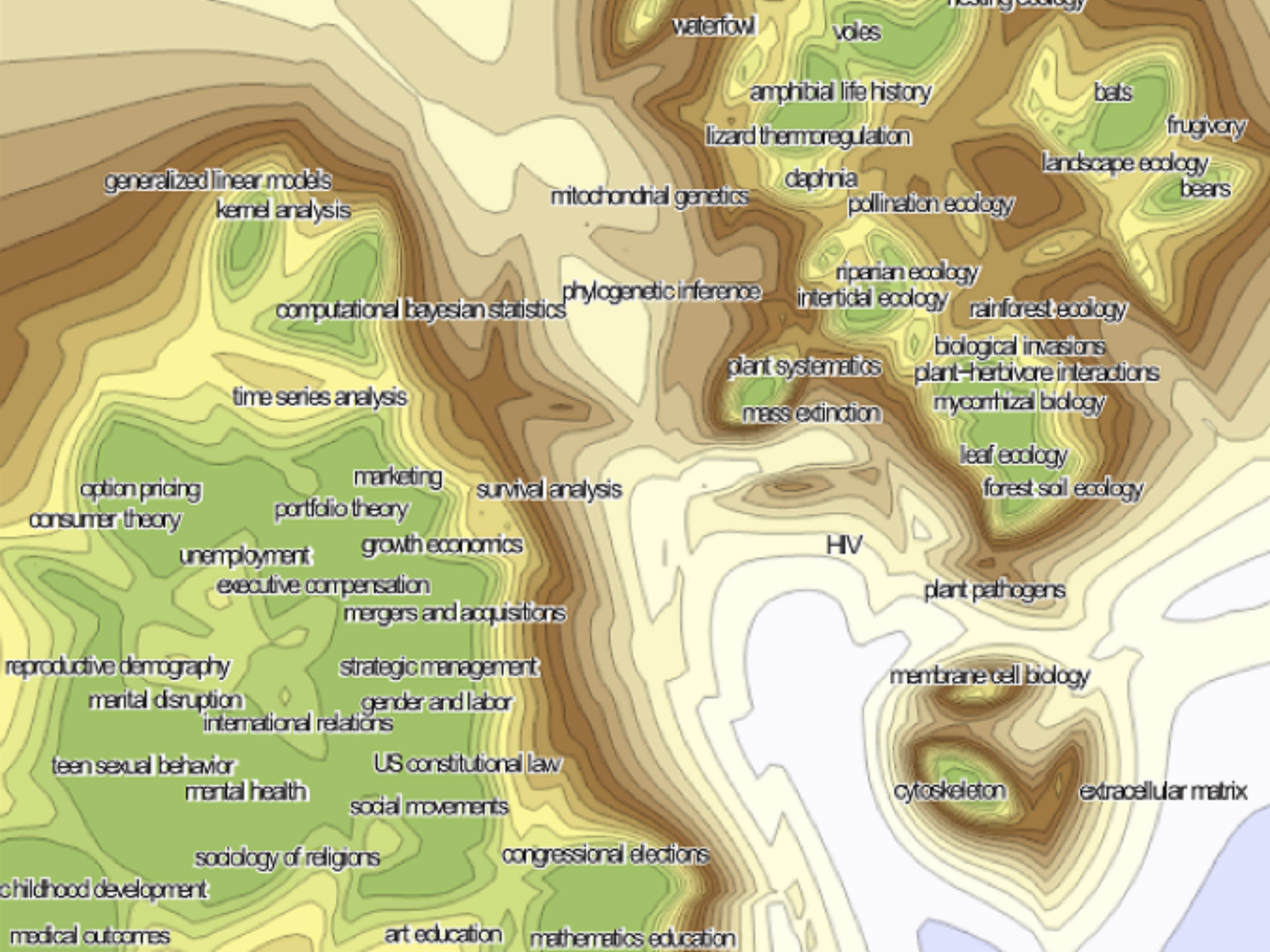
expected message length: $Q(p_i||p_j) = -\sum_{x \in \mathcal{X}} p_i(x) \log_2 p_j(x)$

efficiency of communication

$$E_{ij} = \frac{H(X_i)}{Q(p_i||p_j)} = \frac{-\sum_{x \in \mathcal{X}} p_i(x) \log_2 p_i(x)}{-\sum_{x \in \mathcal{X}} p_i(x) \log_2 p_j(x)}$$

$$C_{ij} = 1 - E_{ij}$$

cultural hole


waterfowl
voles
amphibial life history
bats
frugivory
lizard thermoregulation
landscape ecology
generalized linear models
daphnia
bears
kernel analysis
mitochondrial genetics
pollination ecology
riparian ecology
phylogenetic inference
intertidal ecology
computational bayesian statistics
rainforest ecology
biological invasions
plant systematics
plant–herbivore interactions
time series analysis
mycorrhizal biology
mass extinction
leaf ecology
marketing
option pricing
survival analysis
forest soil ecology
portfolio theory
consumer theory
growth economics
HIV
unemployment
executive compensation
plant pathogens
mergers and acquisitions
reproductive demography
strategic management
membrane cell biology
marital disruption
gender and labor
international relations
teen sexual behavior
US constitutional law
cytoskeleton
extracellular matrix
mental health
social movements
sociology of religions
congressional elections
childhood development
medical outcomes
art education
mathematics education

Summary

- Study the *Science of Science*
- Assemble knowledge graph into machine readable formats
- Ask questions about the origin and evolution of ideas and fields, interdisciplinarity, impact assessment and sociology of science
- Building statistical and visualization tools that improve navigation, make relevant connections and facilitate knowledge discovery
- Eigenfactor.org, Viziometrics.org, Babel.eigenfactor.org

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Poshen Lee, CSE, University of Washington

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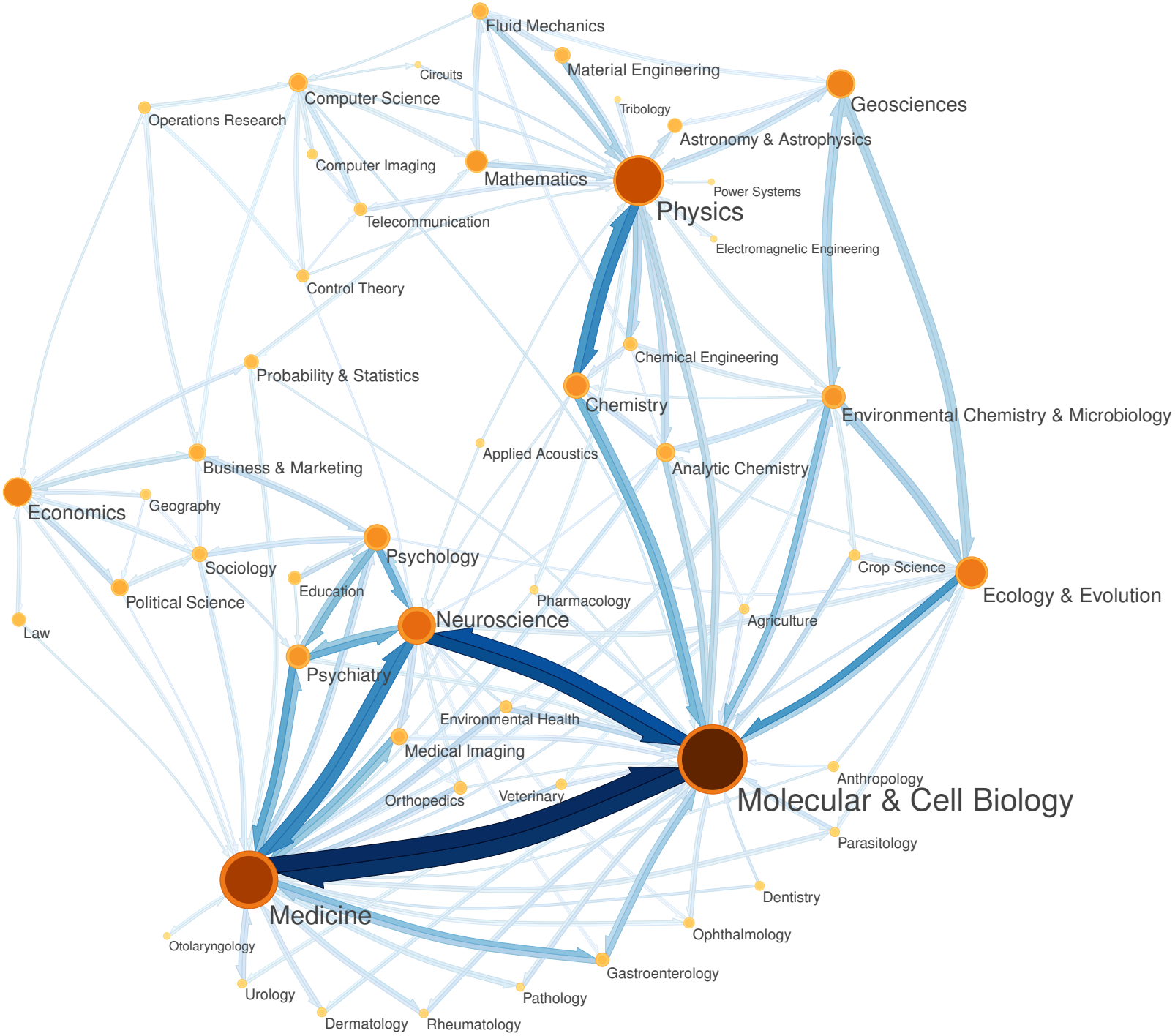
Eigenfactor.org


Fluid Mechanics
Material Engineering
Circuits
Computer Science
Geosciences
Operations Research
Tribology
Astronomy & Astrophysics
Computer Imaging
Mathematics
Power Systems
Physics
Telecommunication
Electromagnetic Engineering
Control Theory
Chemical Engineering
Probability & Statistics
Chemistry
Environmental Chemistry & Microbiology
Applied Acoustics
Business & Marketing
Analytic Chemistry
Economics
Geography
Psychology
Crop Science
Sociology
Education
Political Science
Pharmacology
Ecology & Evolution
Neuroscience
Law
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Psychiatry
Environmental Health
Medical Imaging
Anthropology
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Urology
Pathology
Dermatology
Rheumatology