Title
Data, Digital Scholarship, and DANS

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2015-06-17

Data, Digital Scholarship, and DANS

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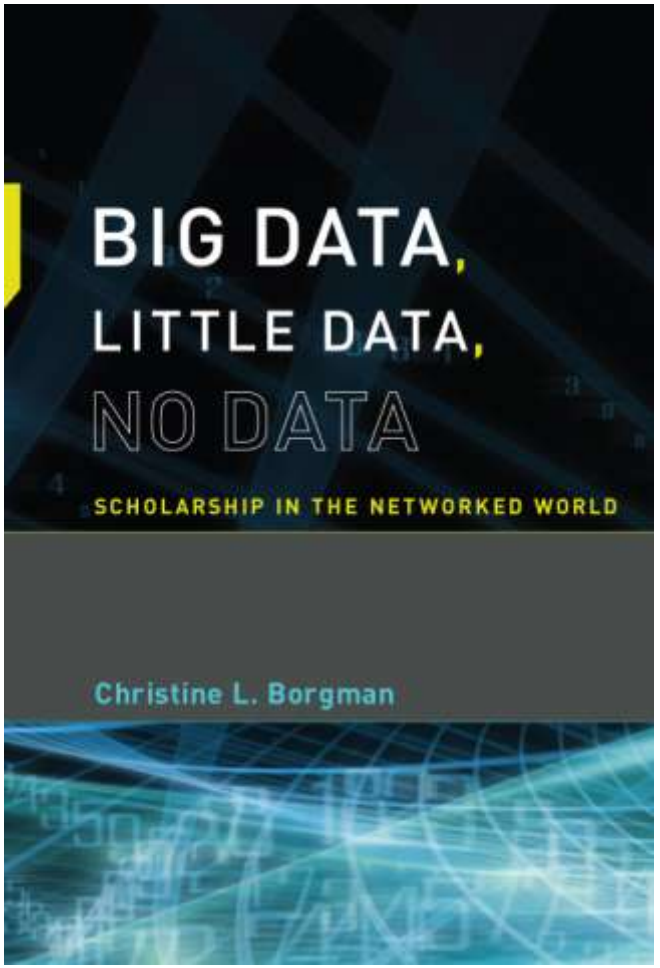
University of California, Los Angeles
Visiting Professor, DANS
@scitechprof

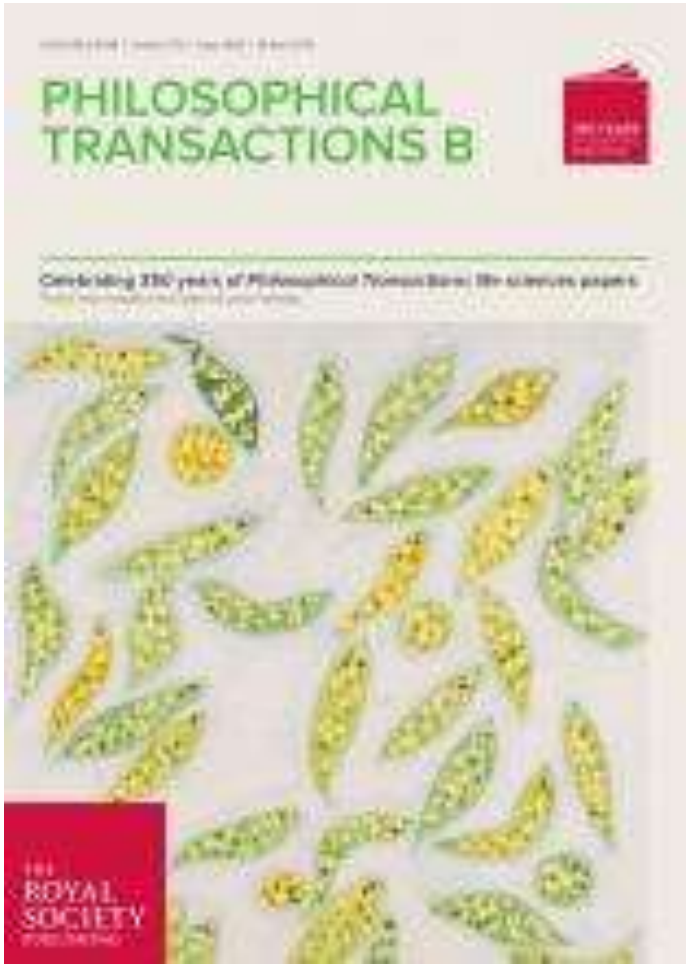
Seminar presentation
Digital Archiving and Networked Services
KNAW / NWO
The Hague
17 June 2015



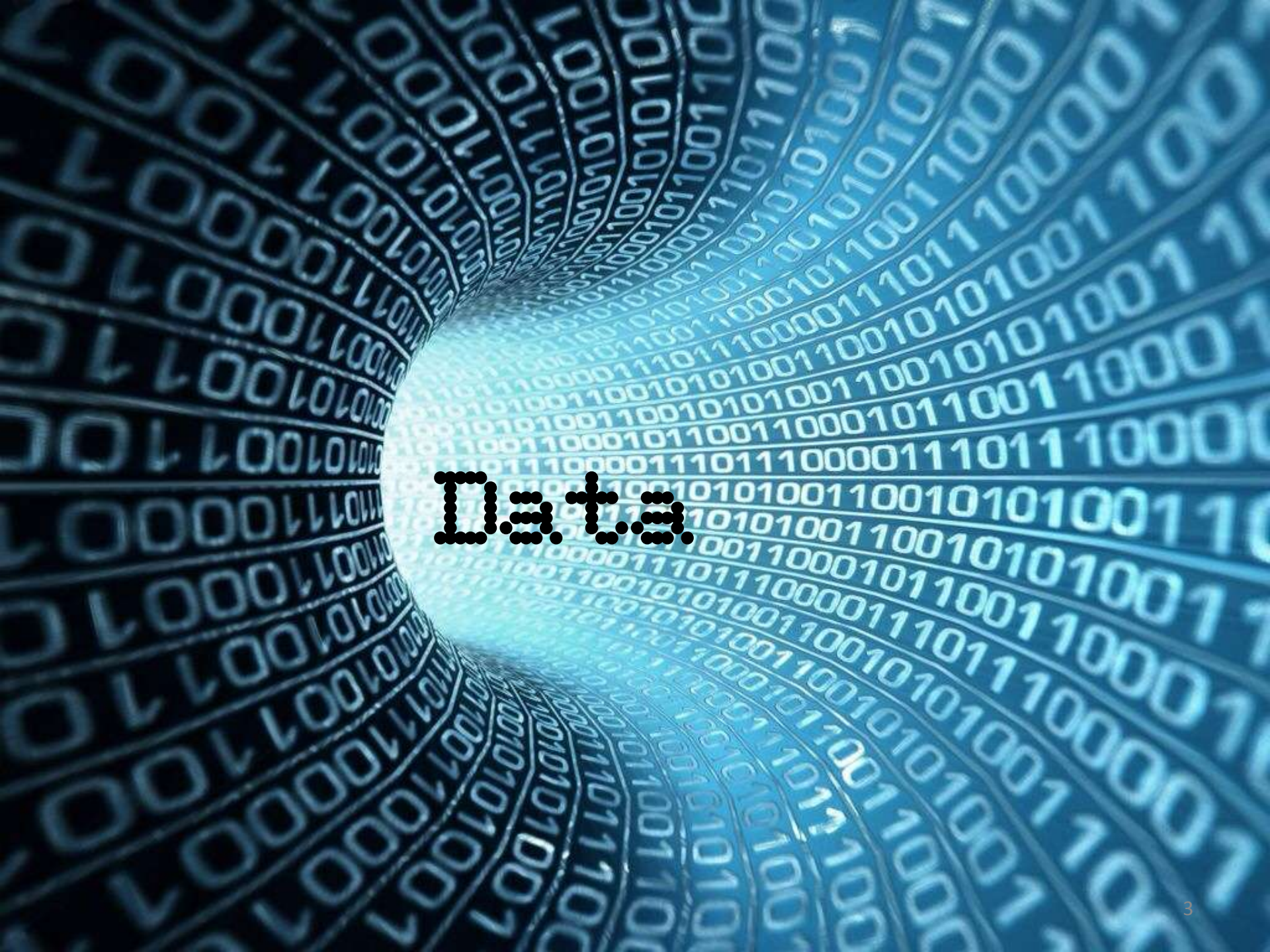
PHILOSOPHICAL
TRANSACTIONS:
GIVING SOME
ACCOMPT
OF THE PRESENT
Undertakings, Studies, and Labours
OF THE
INGENIOUS
IN MANY
CONSIDERABLE PARTS
OF THE
WORLD

Vol I.
For *Anno* 1665, and 1666.

In the *SAVOY*,
Printed by *T. N.* for *John Martyn* at the Bell, a little without *Temple-Bar*, and *James Allestry* in *Duck-Lane*,
Printers to the *Royal Society*.



Theme issue 'Celebrating 350 years of Philosophical Transactions: life sciences papers' compiled and edited by Linda Partridge
19 April 2015; volume 370, issue 1666


Data

Open access policies

- Australian Research Council
  - Code for the Responsible Conduct of Research
  - Data management plans
- National Science Foundation
  - Data sharing requirements
  - Data management plans
- U.S. Federal policy
  - Open access to publications
  - Open access to data
- European Union
  - European Open Data Challenge
  - OpenAIRE
- Research Councils of the UK
  - Open access publishing
  - Provisions for access to data

Australian Government
National Health and Medical Research Council

National Science Foundation
WHERE DISCOVERIES BEGIN

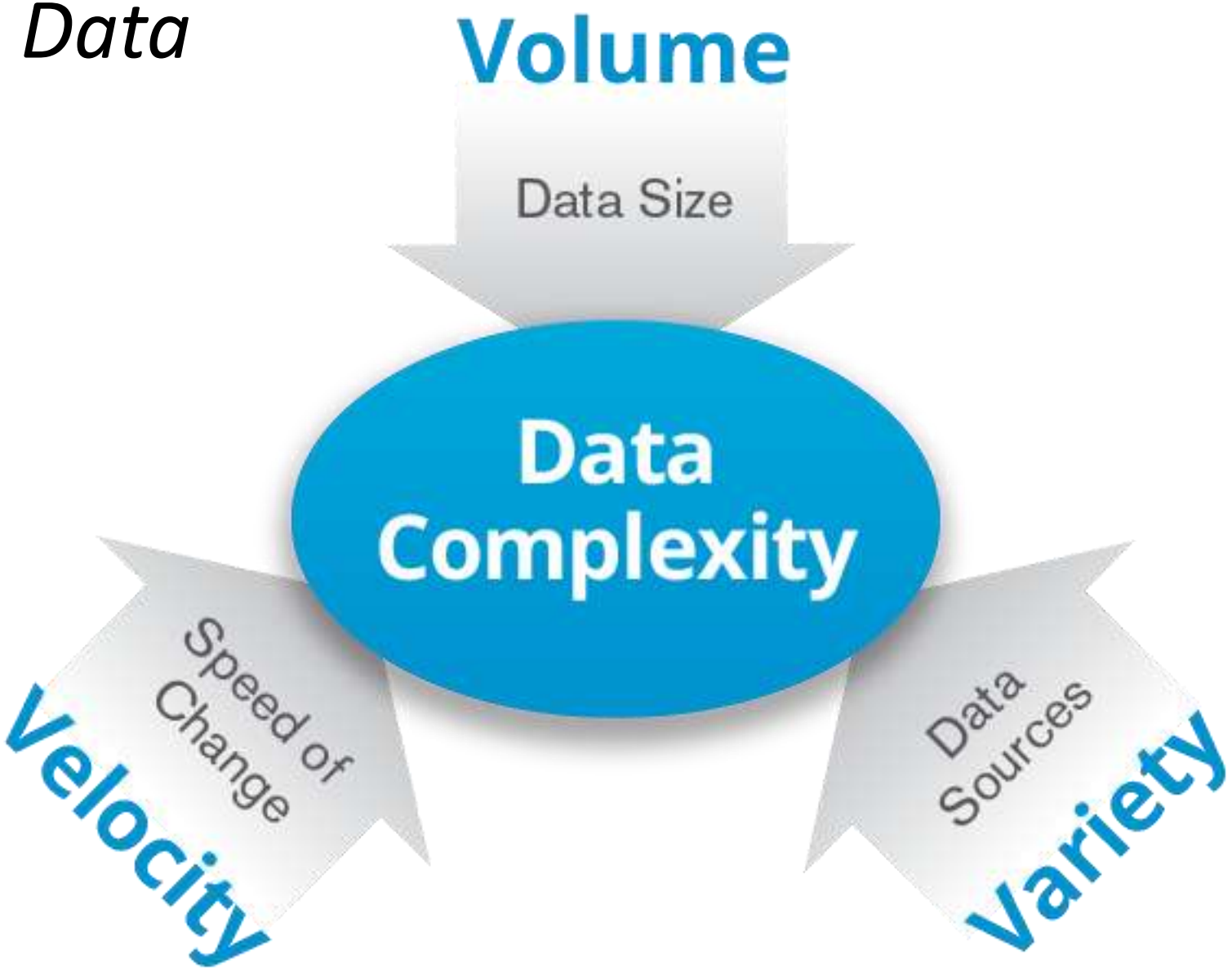
Supported by wellcome trust

Research Data Sharing without barriers

Precondition:

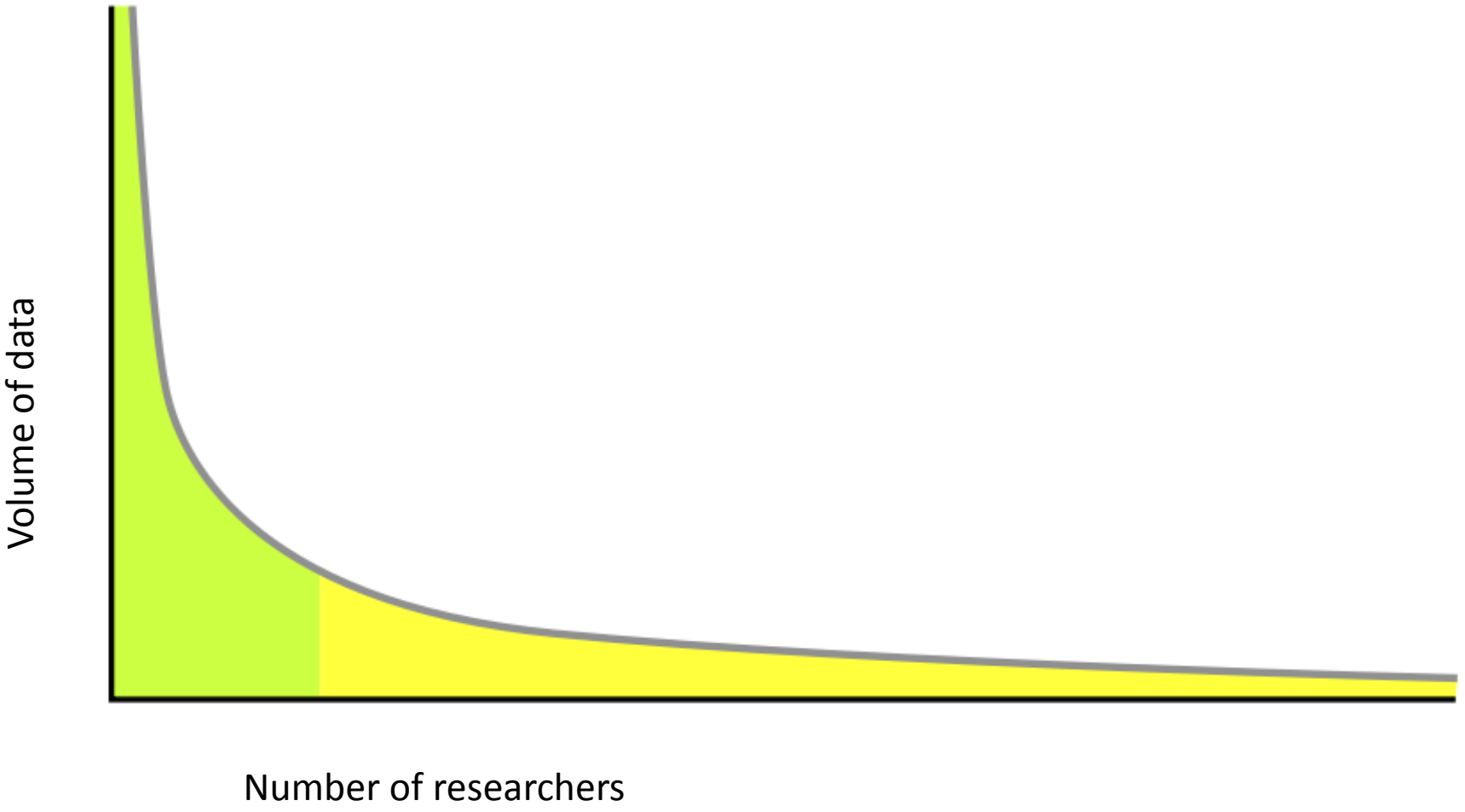
Researchers share data

Big Data



http://www.datameer.com/product/hadoop.html

Long tail of data



Slide: The Institute for Empowering Long Tail Research

Open Data: Free

- A piece of data or content is open if anyone is free to use, reuse, and redistribute it — subject only, at most, to the requirement to attribute and/or share-alike

State Library and Archives of Florida, 1922. Flickr commons photo

Open Data Commons. (2013).

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                        /comma 2 def
                                    /period 3 def
                                                /W 4 def
                                                        /a 5 def
                                                                /b 6 def
                                                                        /c 7
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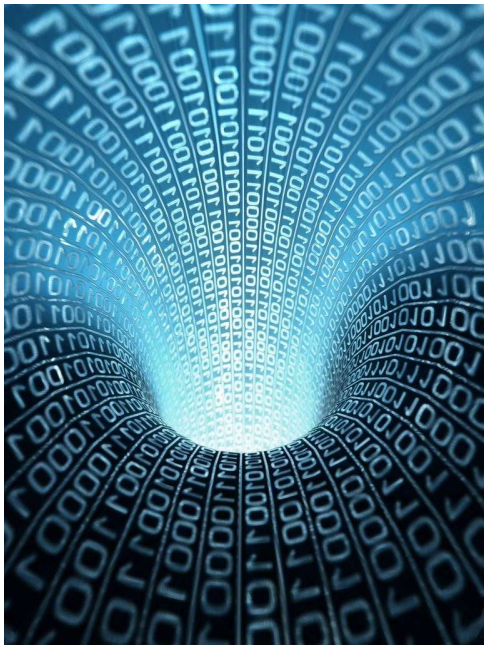
Open Data: Useful

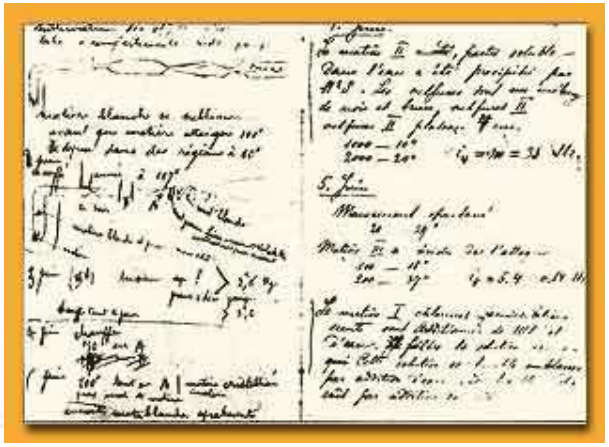
- Openness, flexibility, transparency, legal conformity, protection of intellectual property, formal responsibility, professionalism, interoperability, quality, security, efficiency, accountability, and sustainability.



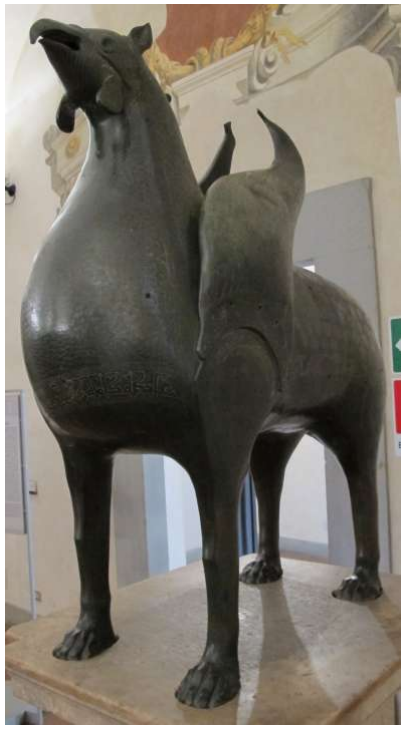
Organization for Economic Cooperation and Development. (2007). *OECD Principles and Guidelines for Access to Research Data from Public Funding*. http://www.oecd.org/dataoecd/9/61/38500813.pdf

What are data?

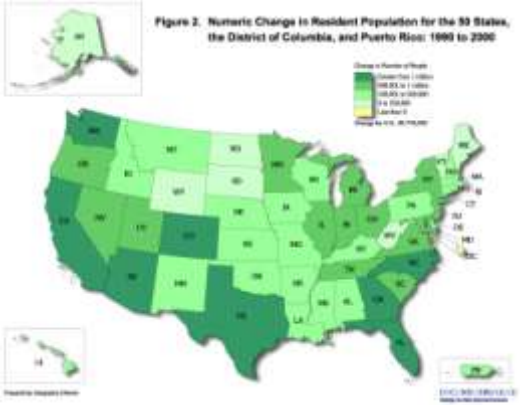
hudsonalpha.org



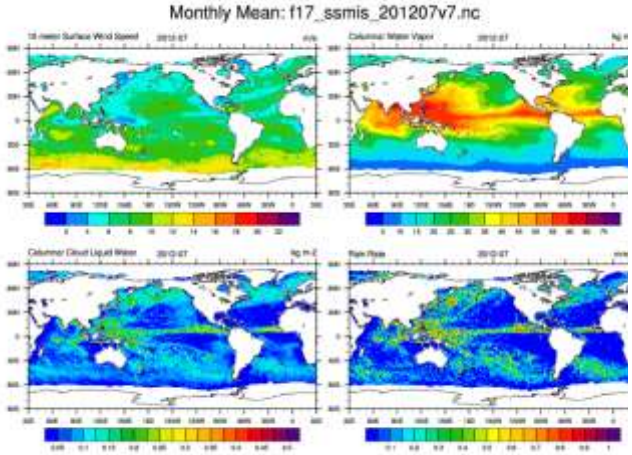
Marie Curie's notebook aip.org



Pisa Griffin



http://www.census.gov/population/cen2000/map02.gif



ncl.ucar.edu

Date:1/2.07.75 Place:Sakaltutan
Zafor
He will grow old in his present house; new house is for sons - 5 sons. Not sure they want to live in village. He will only build another if they want him to. eS came from Germany and did the plastering. He arranged the carpentry in Kayseri. Çok para gitti. {much money went} Has a tractor.

Date:July1980 Place:Sakaltutan
Zafor:
Household now Zafor and wife; Nazif Unal and wife and youngest son, still a boy. They run two dolmuß; one with a driver from Süleymanli. Goes in and out once a day. He gets 8,000 a month. Zafor then said, keskin de©il. { not sharp - i.e.? not profitable} I said he did very well on 8,000 TL with only two journeys a day. Nazif Unal has "bought" a Durak {dolmuß stop} from Belediye and works all day in Kayseri.

http://onlineqda.hud.ac.uk/Intro_QDA/Examples_of_Qualitative_Data.ph

http://www.genome.gov/dmd/img.cfm?node=Photos/Graphics&id=85327

Data are representations of observations, objects, or other entities used as evidence of phenomena for the purposes of research or scholarship.

C.L. Borgman (2015). *Big Data, Little Data, No Data: Scholarship in the Networked World*. MIT Press

WIRED MAGAZINE: 16.07

SCIENCE : DISCOVERIES

The End of Theory: The Data Deluge Makes the Scientific Method Obsolete

By Chris Anderson 06.23.08

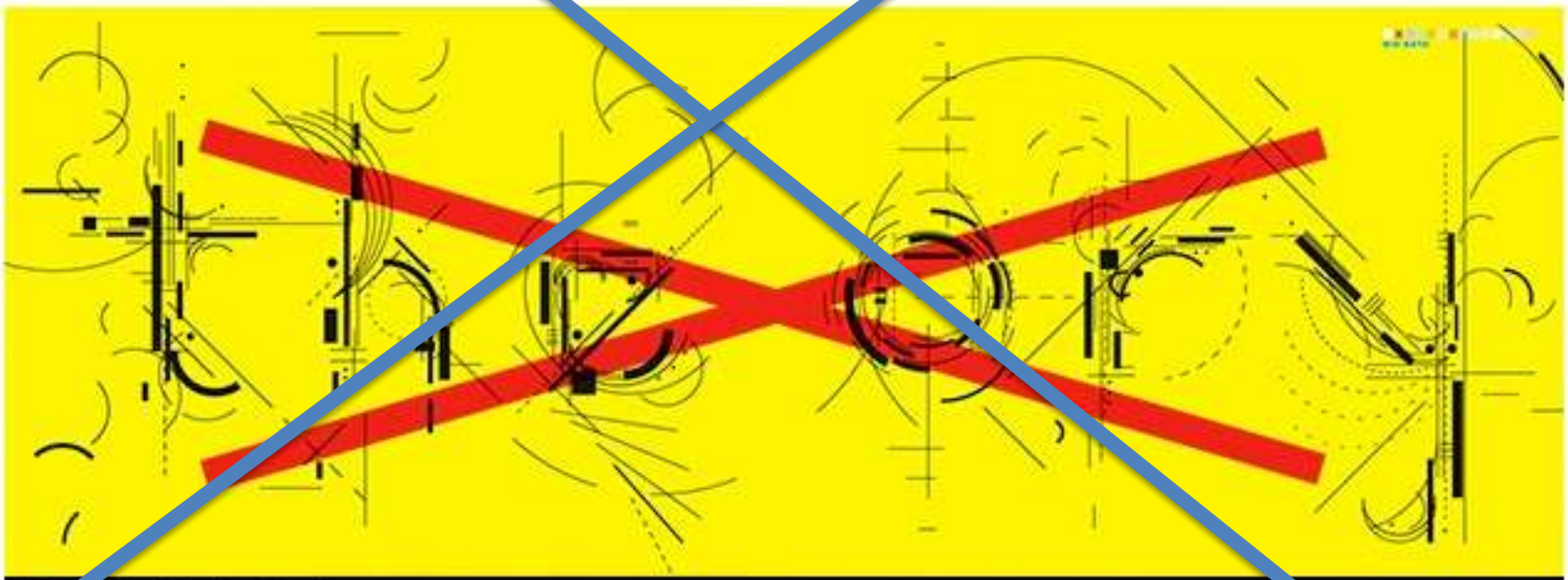
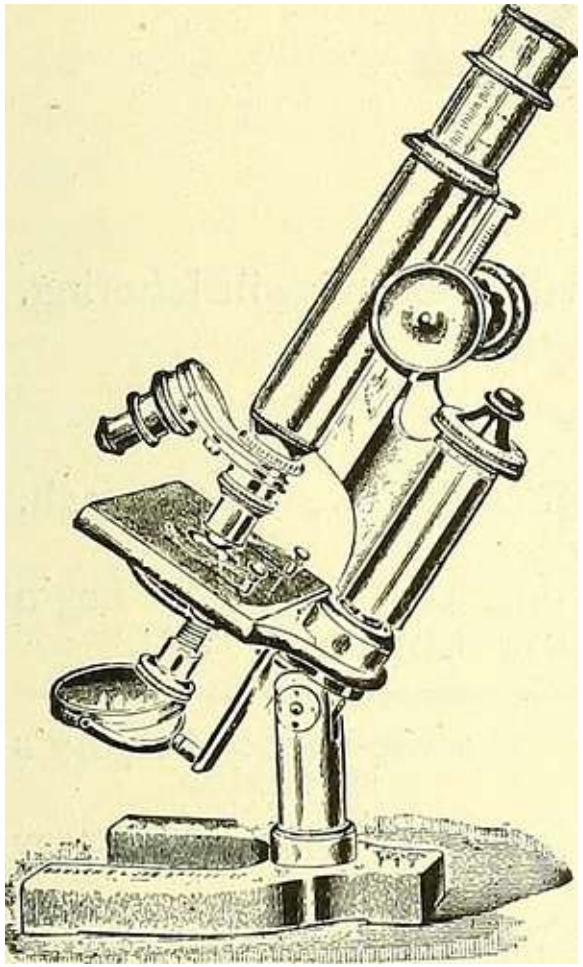


Illustration: Marian Bantjes

Research process

- Models and theories
- Research questions
- Methods
  - Tools
  - Data sources
  - Practices
  - Infrastructure
  - Domain expertise



Commons photo: Science Gossip, 1894

Telescope for the Sloan Digital Sky Survey, Apache Point, New Mexico

LETTERS

A role for self-gravity at multiple length scales in the process of star formation

Alyssa A. Goodman[1,2], Erik W. Rosolowsky[2,3], Michelle A. Borkin[1]†, Jonathan B. Foster[2], Michael Halle[1,4], Jens Kauffmann[1,2] & Jaime E. Pineda[2]

Self-gravity plays a decisive role in the final stages of star formation, where dense cores (size ~0.1 parsecs) inside molecular clouds collapse to form star-plus-disk systems[1]. But self-gravity's role at earlier times (and on larger length scales, such as ~1 parsec) is unclear; some molecular cloud simulations that do not include self-gravity suggest that 'turbulent fragmentation' alone is sufficient to create a mass distribution of dense cores that resembles, and sets, the stellar initial mass function[2]. Here we report a 'dendrogram' (hierarchical tree-diagram) analysis that reveals that self-gravity plays a significant role over the full range of possible scales traced by ^{13}CO observations in the L1448 molecular cloud, but not everywhere in the observed region. In particular, more than 90 per cent of the compact 'pre-stellar cores' traced by peaks of dust emission[3] are projected on the sky within one of the dendrogram's self-gravitating 'leaves'. As these peaks mark the locations of already-forming stars, or of those probably about to form, a self-gravitating cocoon seems a critical condition for their existence. Turbulent fragmentation simulations without self-gravity—even of unmagnetized isothermal material—can yield mass and velocity power spectra very similar to what is observed in clouds like L1448. But a dendrogram of such a simulation[4] shows that nearly all the gas in it (much more than in the observations) appears to be self-gravitating. A potentially significant role for gravity in 'non-self-gravitating' simulations suggests inconsistency in simulation assumptions and output, and that it is necessary to include self-gravity in any realistic simulation of the star-formation process on subparsec scales.

Spectral-line mapping shows whole molecular clouds (typically tens to hundreds of parsecs across, and surrounded by atomic gas) to be marginally self-gravitating[5]. When attempts are made to further break down clouds into pieces using 'segmentation' routines, some self-gravitating structures are always found on whatever scale is sampled[6,7]. But no observational study to date has successfully used one spectral-line data cube to study how the role of self-gravity varies as a function of scale and conditions, within an individual region.

Most past structure identification in molecular clouds has been explicitly non-hierarchical, which makes difficult the quantification of physical conditions on multiple scales using a single data set. Consider, for example, the often-used algorithm CLUMPFIND[7]. In three-dimensional (3D) spectral-line data cubes, CLUMPFIND operates as a watershed segmentation algorithm, identifying local maxima in the position–position–velocity (p–p–v) cube and assigning nearby emission to each local maximum. Figure 1 gives a two-dimensional (2D) view of L1448, our sample star-forming region, and Fig. 2 includes a CLUMPFIND decomposition of it based on ^{13}CO observations. As with any algorithm that does not offer hierchically nested or overlapping features as an option, significant emission found between prominent clumps is typically either appended to the nearest clump or turned into a small, usually 'pathological', feature needed to encompass all the emission being modelled. When applied to molecular-line

Figure 1 | Near-infrared image of the L1448 star-forming region with contours of molecular emission overlaid. The channels of the colour image correspond to the near-infrared bands J (blue), H (green) and K (red), and the contours of integrated intensity are from ^{13}CO(1–0) emission[8]. Integrated intensity is monotonically, but not quite linearly (see Supplementary Information), related to column density[14], and it gives a view of 'all' of the molecular gas along lines of sight, regardless of distance or velocity. The region within the yellow box immediately surrounding the protostars has been imaged more deeply in the near-infrared (using Calar Alto) than the remainder of the box (2MASS data only), revealing protostars as well as the scattered starlight known as 'Cloudshine'[11] and outflows (which appear orange in this colour scheme). The four billiard-ball labels indicate regions containing self-gravitating dense gas, as identified by the dendrogram analysis, and the leaves they identify are best shown in Fig. 2a. Asterisks show the locations of the four most prominent embedded young stars or compact stellar systems in the region (see Supplementary Table 1), and yellow circles show the millimetre-dust emission peaks identified as star-forming or 'pre-stellar' cores[3].

[1]Initiative in Innovative Computing at Harvard, Cambridge, Massachusetts 02138, USA. [2]Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts 02138, USA. [3]Department of Physics, University of British Columbia, Okanagan, Kelowna, British Columbia V1V 1V7, Canada. [4]Surgical Planning Laboratory and Department of Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts 02115, USA. †Present address: School of Engineering and Applied Sciences, Harvard University, Cambridge, Massachusetts 02138, USA.

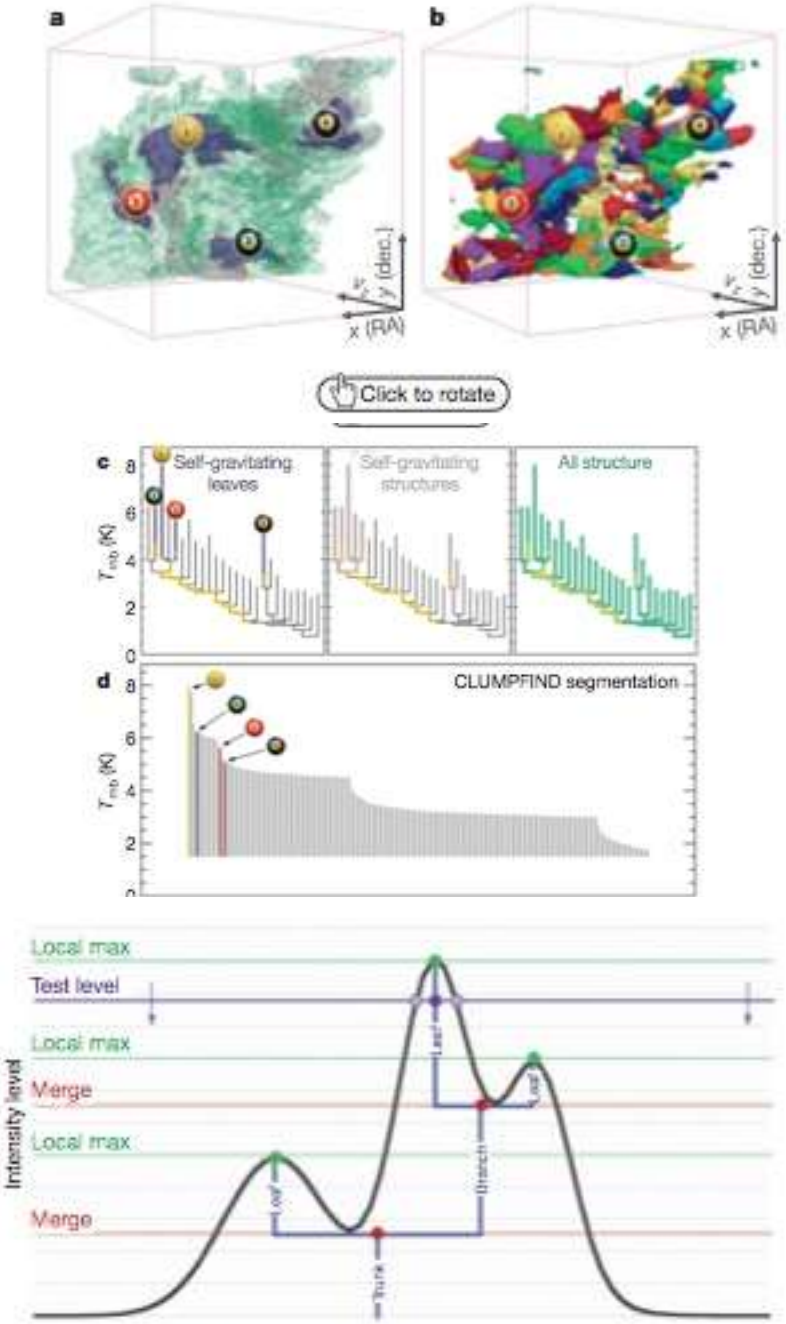
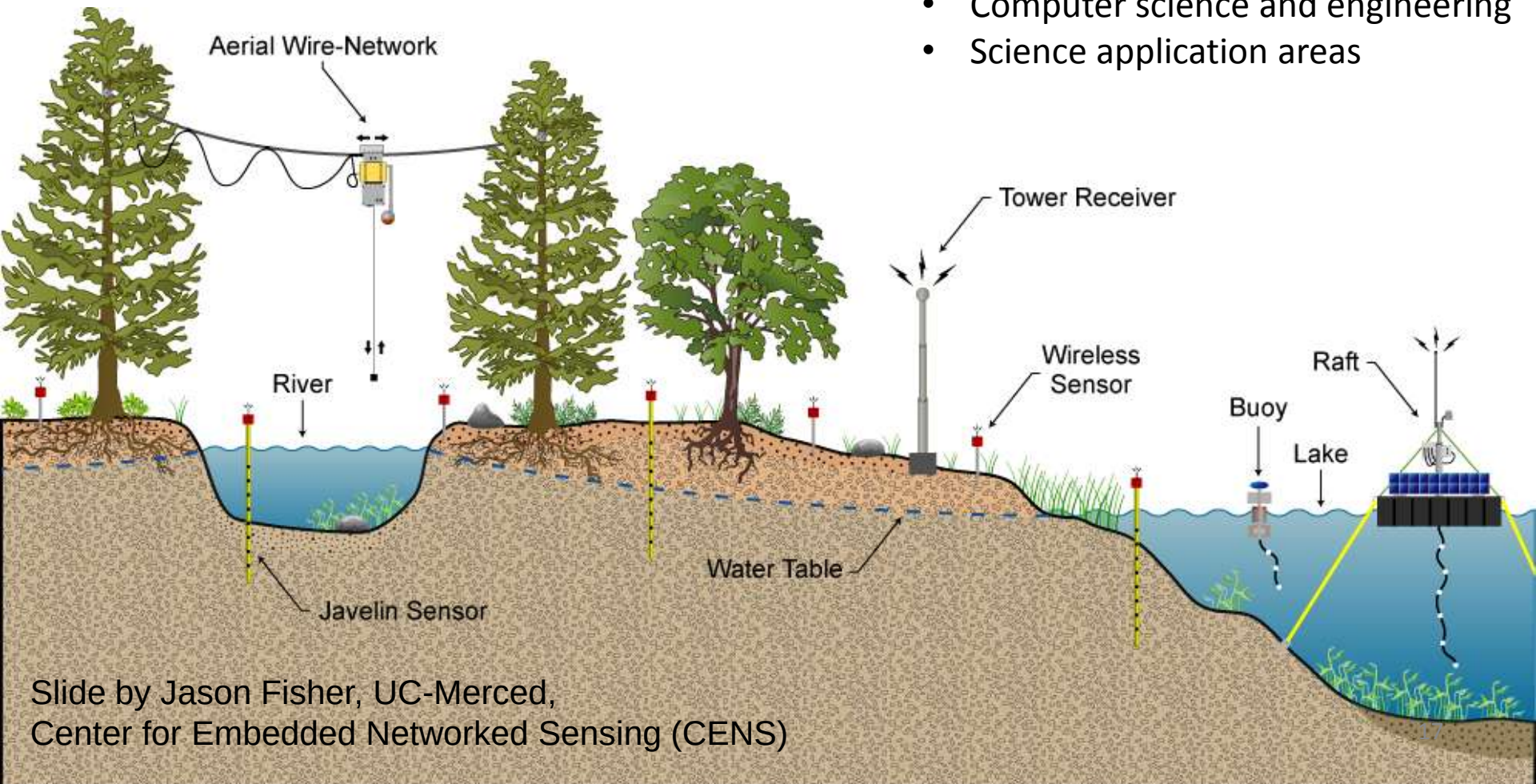


Figure 3 | Schematic illustration of the dendrogram process. Shown is the

Center for Embedded Networked Sensing

- NSF Science & Tech Ctr, 2002-2012
- 5 universities, plus partners
- 300 members
- Computer science and engineering
- Science application areas



Slide by Jason Fisher, UC-Merced,
Center for Embedded Networked Sensing (CENS)

Science <–> Data

Engineering researcher:
"Temperature is temperature."

CENS Robotics team

Biologist*:* ***"There are hundreds of ways to measure temperature.*** *'The temperature is 98' is low-value compared to, 'the temperature of the surface, measured by the infrared thermopile, model number XYZ, is 98.' That means it is measuring a proxy for a temperature, rather than being in contact with a probe, and it is measuring from a distance. The accuracy is plus or minus .05 of a degree. I [also] want to know that it was taken outside versus inside a controlled environment, how long it had been in place, and the last time it was calibrated, which might tell me whether it has drifted.."*

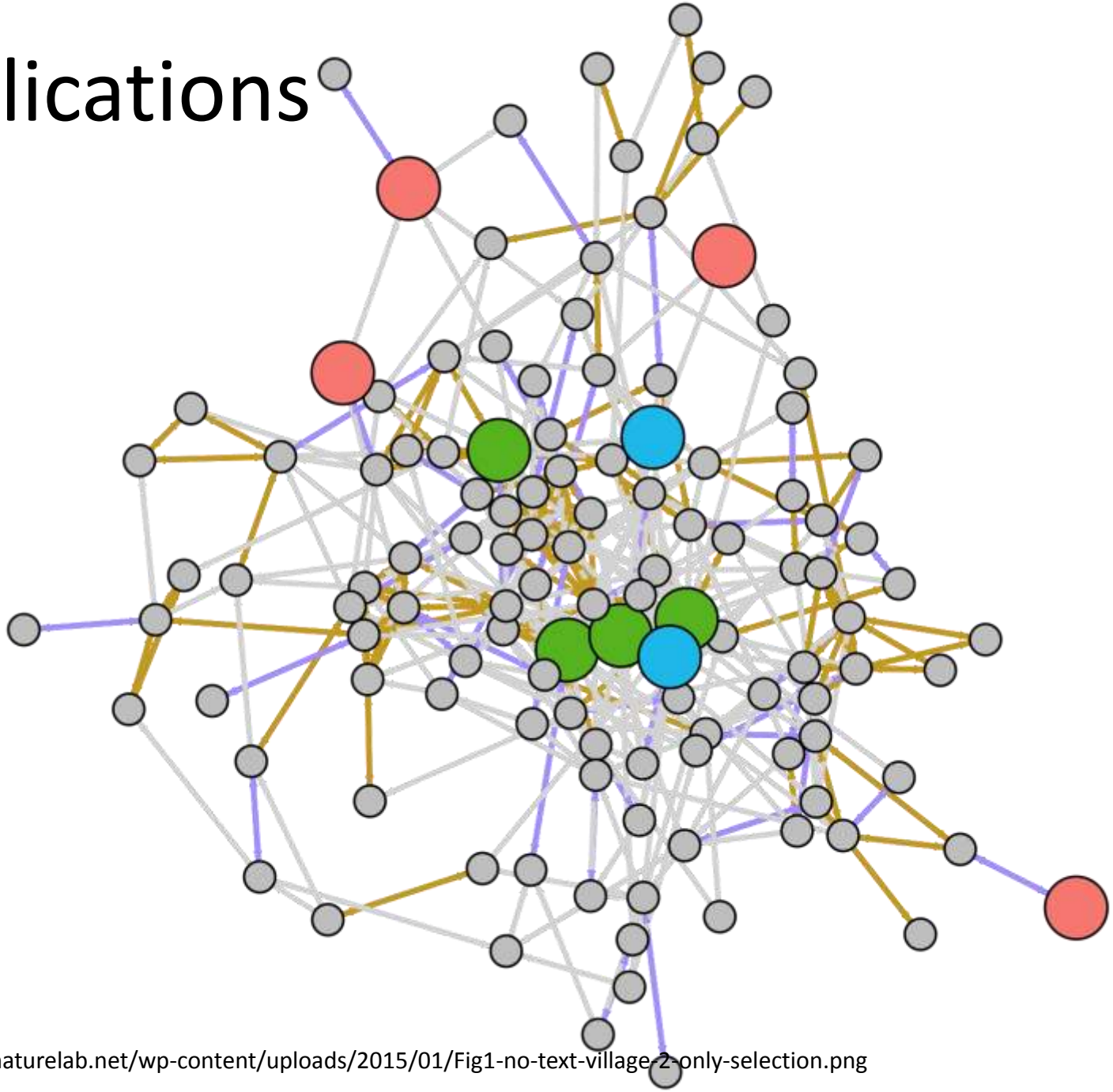
http://vcg.isti.cnr.it/griffin/

Arte islamica, ippogrifo, XI sec 03, own work

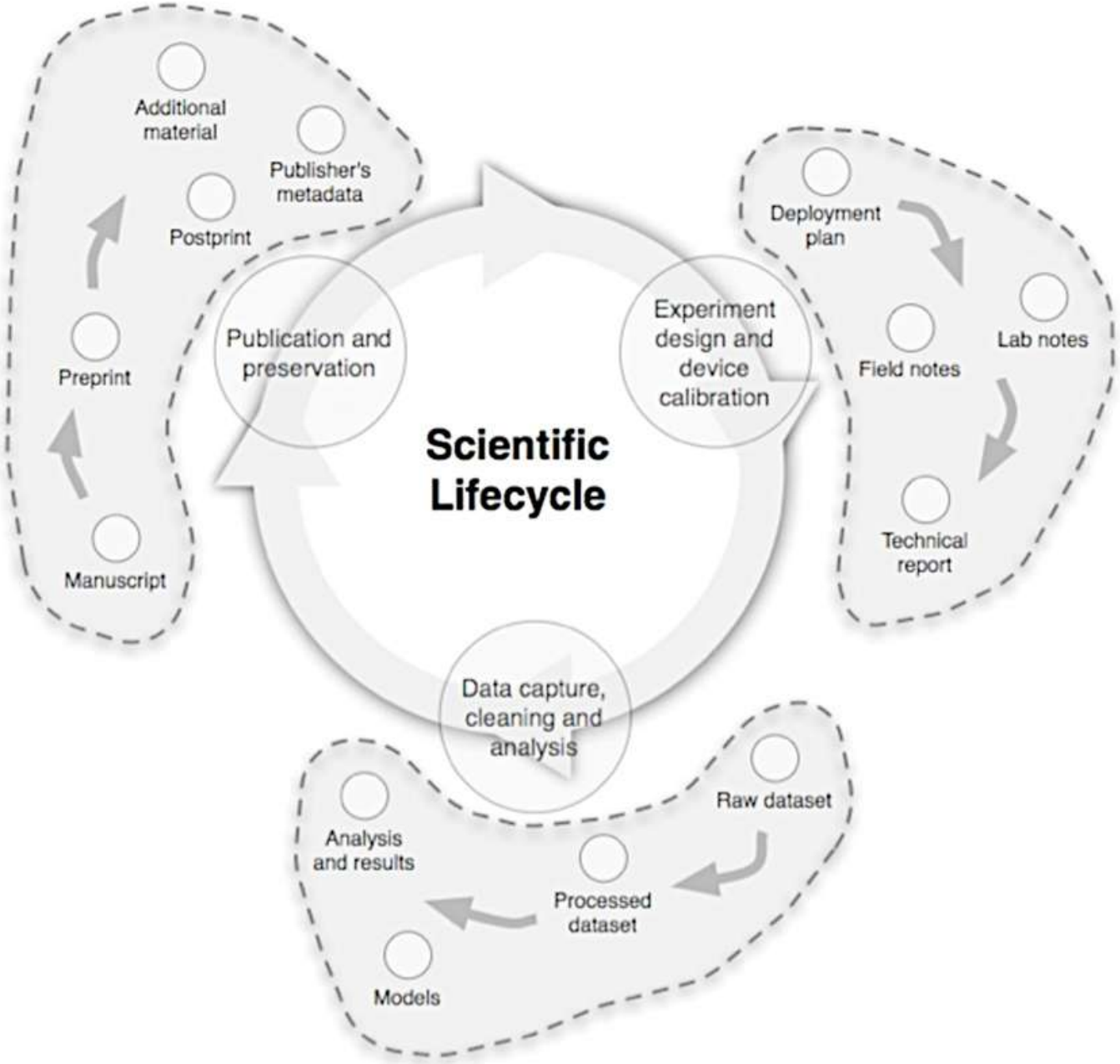
Publications

http://www.cse.psu.edu/hpcl/images/publications.jpg

Publications



http://humannaturelab.net/wp-content/uploads/2015/01/Fig1-no-text-village-2-only-selection.png



Pepe, A., Mayernik, M. S., Borgman, C. L. & Van de Sompel, H. (2010). From Artifacts to Aggregations: Modeling Scientific Life Cycles on the Semantic Web. Journal of the American Society for Information Science and Technology, 61(3): 567–582.

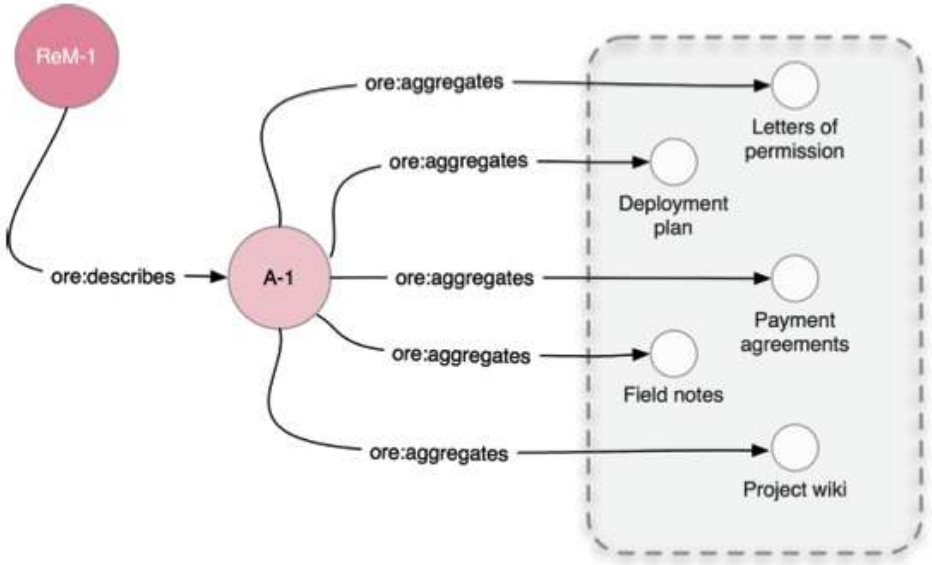


FIG. 4. ORE Aggregation representing the first stage of the scientific life cycle of a sensor network application in seismology (experiment and deployment planning).

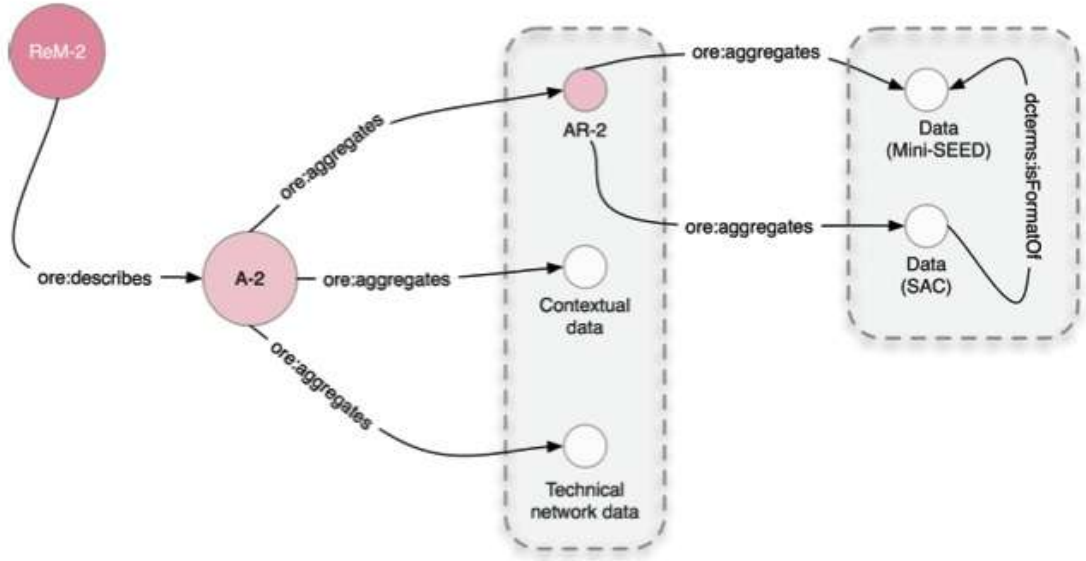
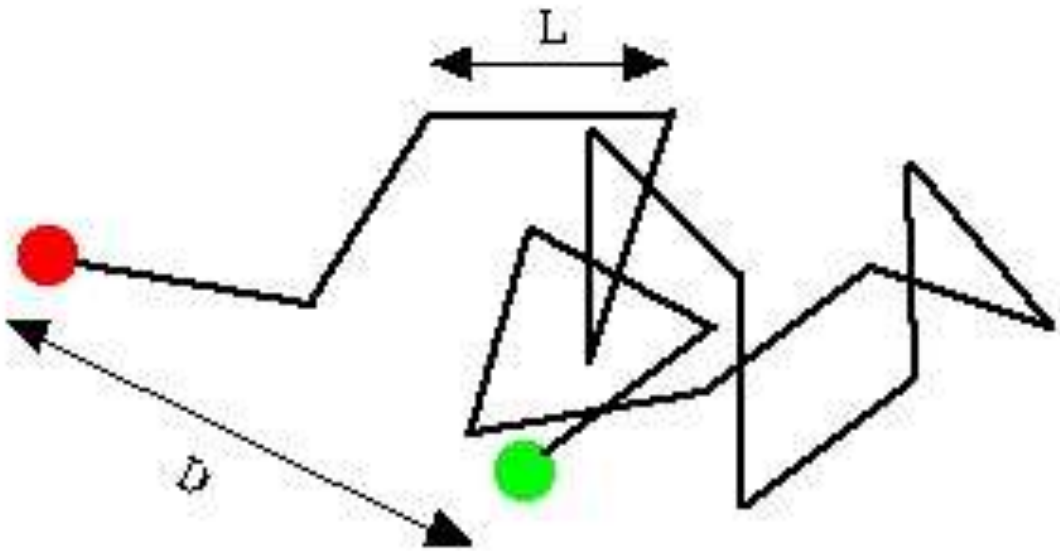


FIG. 5. ORE Aggregation representing the second stage of the scientific life cycle of a sensor network application in seismology (data collection).

Random walk



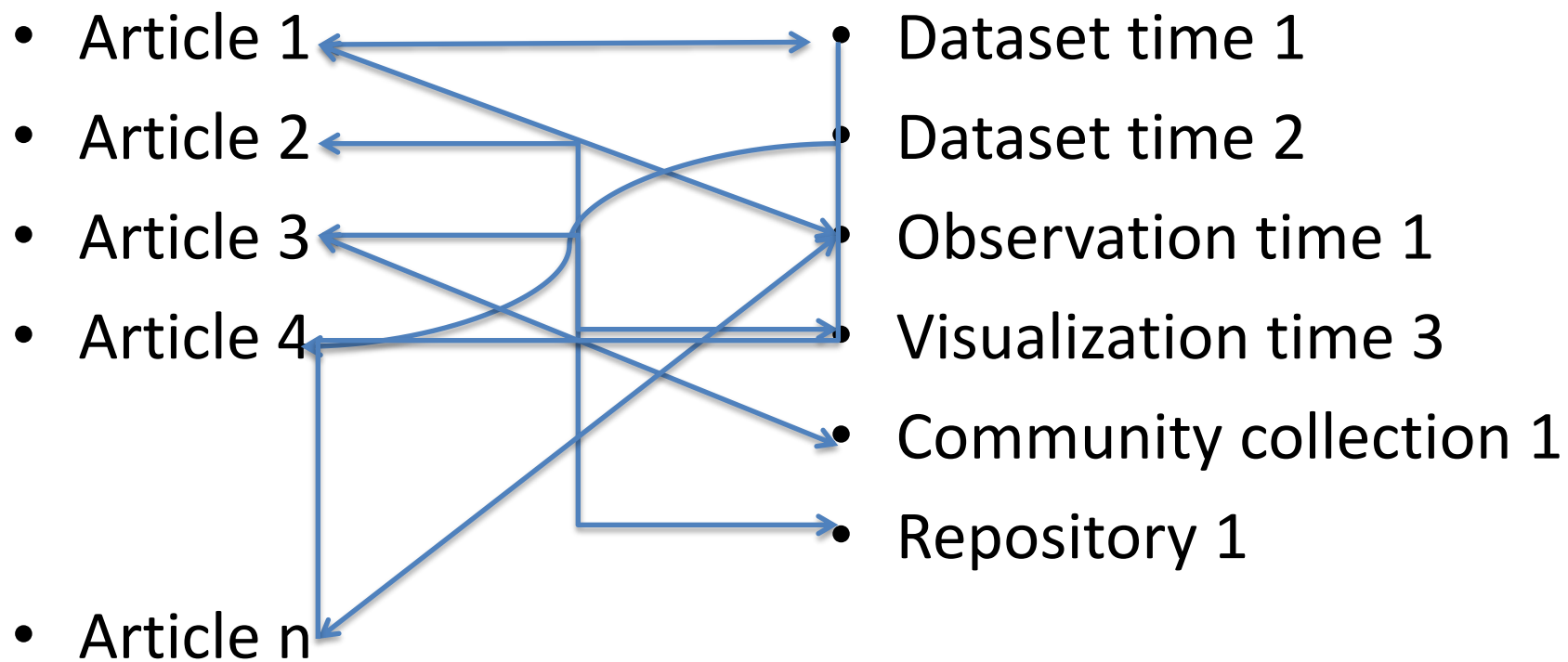
http://www2.ess.ucla.edu/~jewitt/oort2-random.html

Publications <–> Data: Role

Publications are arguments made by authors, and data are the evidence used to support the arguments.

C.L. Borgman (2015). *Big Data, Little Data, No Data: Scholarship in the Networked World*. MIT Press

Publications <–> Data: Mapping



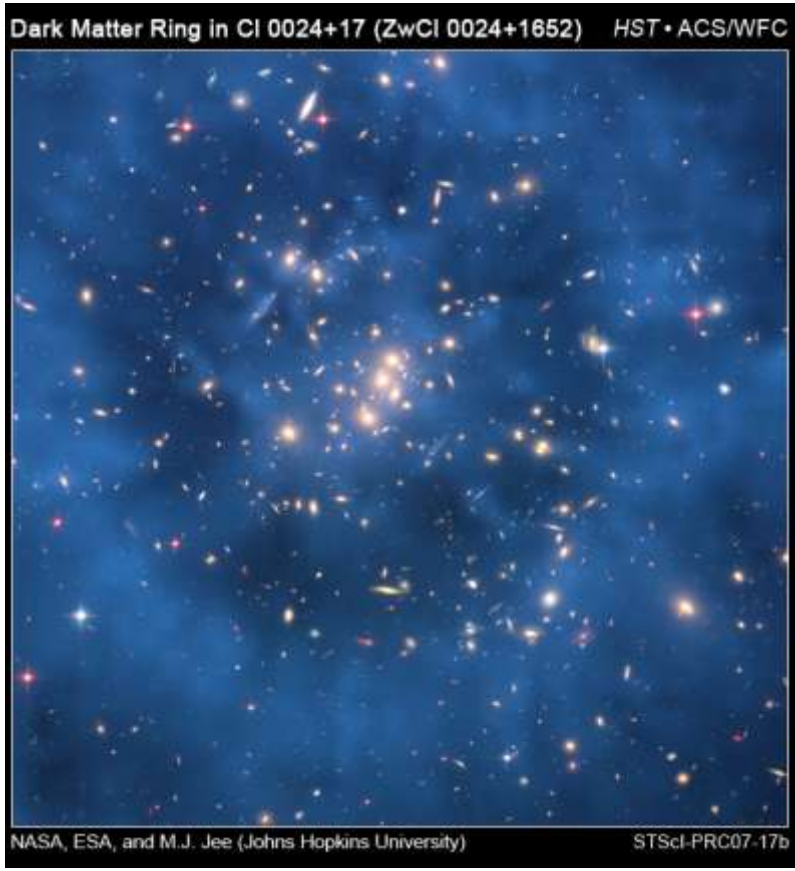
Publications <–> Data: Attribution

- Publications
  - Independent units
  - Authorship is negotiated
- Data
  - Compound objects
  - Ownership is rarely clear
  - Attribution
    - Long term responsibility: Investigators
    - Expertise for interpretation: Data collectors and analysts

http://www.genome.gov/dmd/img.cfm?node=Photos/Graphics&id=85327

Publications <–> Data: Citations

"If publications are the stars and planets of the scientific universe, data are the 'dark matter' – influential but largely unobserved in our mapping process"*



*Micah Altman, CODATA-ICSTI Task Group on Data Citation Standards and Practices, 2013, p. 54

Data citation and analytics

- Credit
- Attribution
- Discovery

Bibliometrics, Scientometrics, Informetrics, Webometrics…

Broken Promises of Privacy 1709

data—associating stored genes with nonidentifying numbers—to protect privacy.[19] Other guidelines recommend anonymization in contexts such as electronic commerce,[20] internet service provision,[21] data mining,[22] and national security data sharing.[23] Academic researchers rely heavily on anonymization to protect human research subjects, and their research guidelines recommend anonymization generally,[24] and specifically in education,[25] computer network monitoring,[26] and health studies.[27] Professional statisticians are duty-bound to anonymize data as a matter of professional ethics.[28]

Market pressures sometimes compel businesses to anonymize data. For example, companies like mint.com and wesabe.com provide web-based personal finance tracking and planning.[29] One way these companies add value is by aggregating and republishing data to help their customers compare their spending with that of similarly situated people.[30] To make customers comfortable with this type of data sharing, both mint.com and wesabe.com promise to anonymize data before sharing it.[31]

Architecture, defined in Lessig's sense as technological constraints,[32] often forces anonymization, or at least makes anonymization the default choice. As one example, whenever you visit a website, the distant computer with which you communicate—also known as the web server—records some information

19. Roberto Andorno, *Population Genetic Databases: A New Challenge to Human Rights*, in ETHICS AND LAW OF INTELLECTUAL PROPERTY 39 (Christian Lenk, Nils Hoppe & Roberto Andorno eds., 2007).
20. ALEX BERSON & LARRY DUBOV, MASTER DATA MANAGEMENT AND CUSTOMER DATA INTEGRATION FOR A GLOBAL ENTERPRISE 338–39 (2007).
21. *See infra* Part II.A.3.b.
22. G.K. GUPTA, INTRODUCTION TO DATA MINING WITH CASE STUDIES 432 (2006).
23. MARKLE FOUND. TASK FORCE, CREATING A TRUSTED NETWORK FOR HOMELAND SECURITY 144 (2003), *available at* http://www.markle.org/downloadable_assets/nstf_report2_full_report.pdf.
24. *See* THE SAGE ENCYCLOPEDIA OF QUALITATIVE RESEARCH METHODS 196 (Lisa M. Given ed., 2008) (entry for "Data Security").
25. LOUIS COHEN ET AL., RESEARCH METHODS IN EDUCATION 189 (2005).
26. *See* Ruoming Pang et al., *The Devil and Packet Trace Anonymization*, 36 COMP. COMM. REV. 29 (2006).
27. INST. OF MED., PROTECTING DATA PRIVACY IN HEALTH SERVICES RESEARCH 178 (2000).
28. European Union Article 29 Data Protection Working Party, *Opinion 4/2007 on the Concept of Personal Data*, 01248/07/EN WP 136, at 21 (June 20, 2007) [hereinafter 2007 Working Party Opinion], *available at* http://ec.europa.eu/justice_home/fsj/privacy/docs/wpdocs/2007/wp136_en.pdf.
29. *See* Eric Bensdorff, *Spend and Save the Social Way—Personal Technology*, SEATTLE TIMES, Nov. 8, 2008, at A9.
30. *See* Carolyn Y. Johnson, *Online Social Networking Meets Personal Finance*, N.Y. TIMES, Aug. 7, 2007, *available at* http://www.nytimes.com/2007/08/07/technology/07iht-debt.1.7013213.html.
31. *See, e.g.*, Wesabe, Security and Privacy, http://www.wesabe.com/page/security (last visited June 12, 2010); Mint.com, How Mint Personal Finance Management Protects Your Financial Safety, http://www.mint.com/privacy (last visited June 12, 2010).
32. LESSIG, *supra* note 18, at 4.

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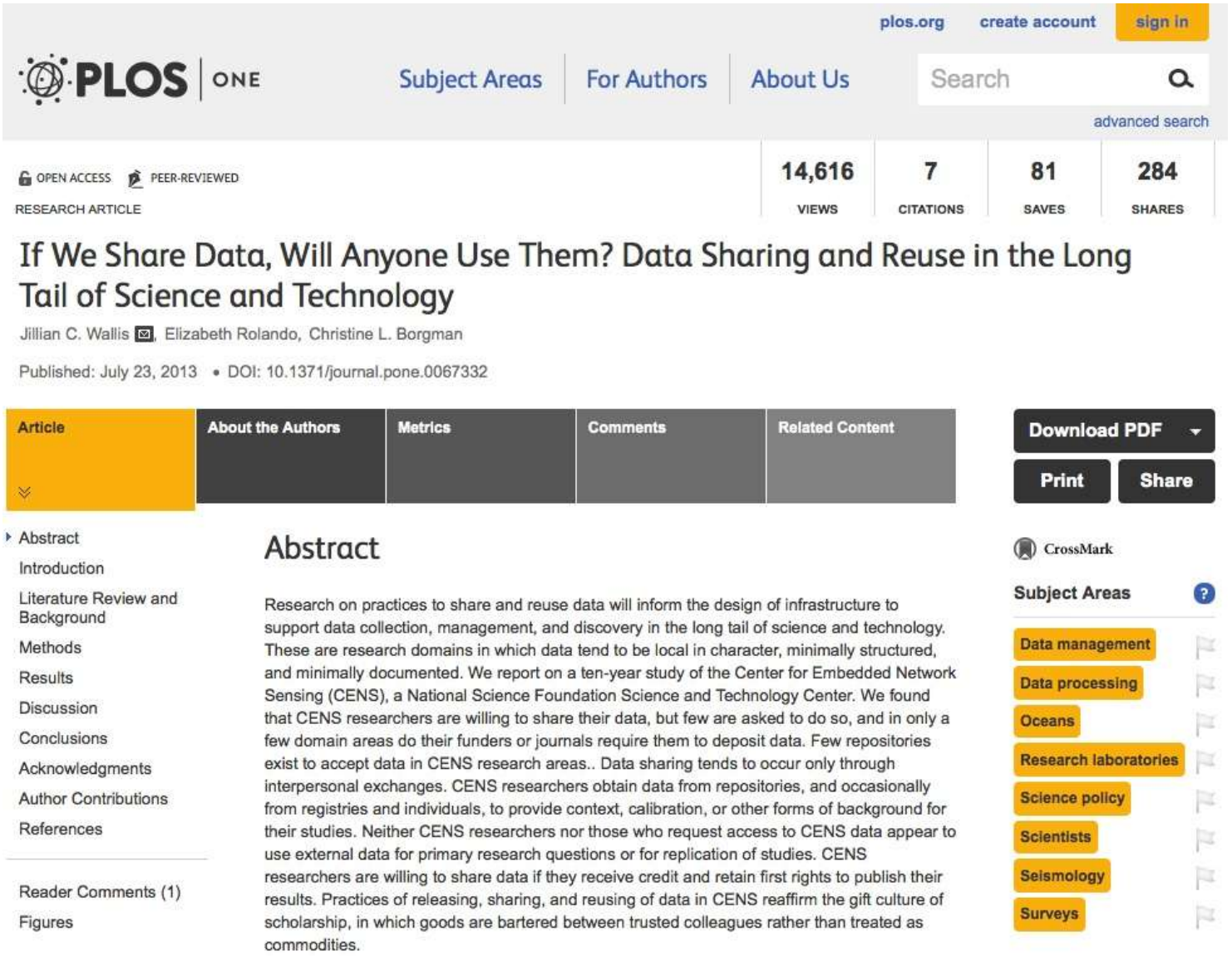
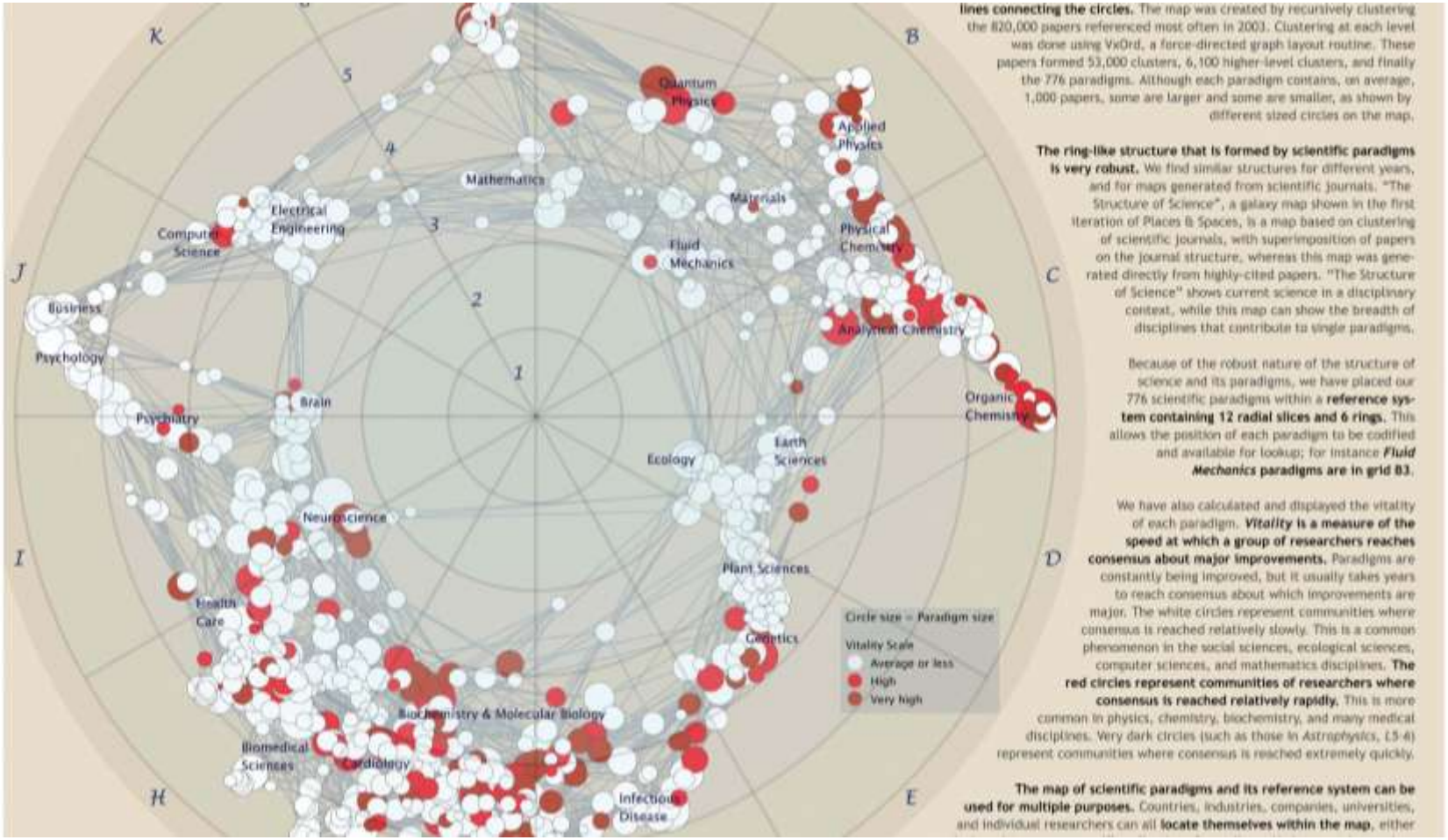
Altmetrics



Published July 23, 2013; Altmetrics data as of Nov 5, 2014

Mapping Scholarship



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5. Making Data Count: A Data Metrics Pilot ...

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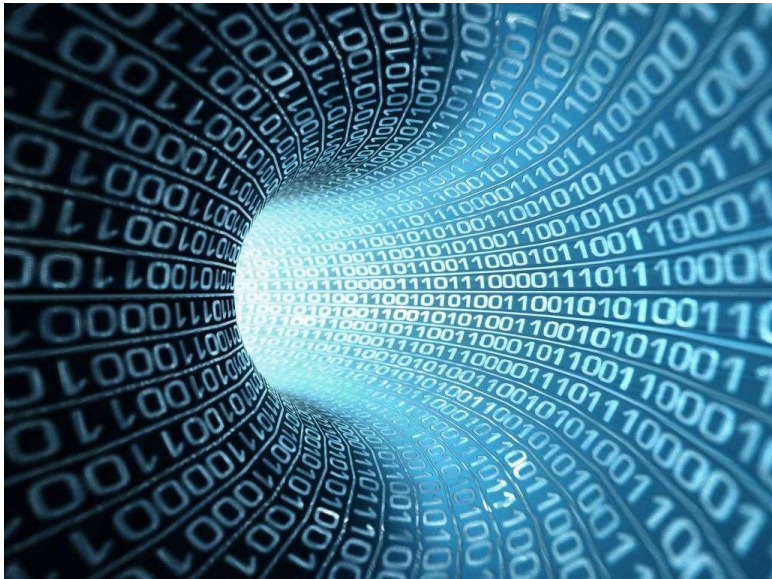
Publish the results.

eScholarship by the Numbers

Views Since 2002:	23,216,720
Publications:	75,712
Research Units:	338
Journals:	70

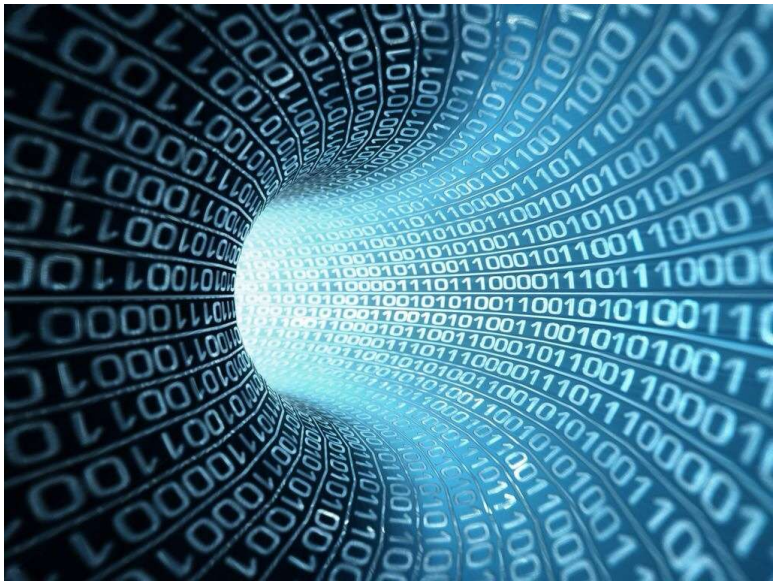
Research data: Scholars' concerns

- Research data management policies
- Expertise, curation, stewardship, resources
- Open records laws
- Human subjects regulations



Publication data: Scholars' concerns

- Library management
- Academic personnel records
- Evaluation and credit
- Public-private partnerships
- Data governance…



Metrics from Open Data

Searches for author: Christine Borgman, Christine L. Borgman, CL Borgman (excluding other C Borgman authors) on July 28, 2014			
Source	Publications	Citations received	H-index
Google Scholar (Google)	380	7766	39
Web of Science (Thomson-Reuters)	145	1629	20
Scopus (Elsevier)	77	1314	14 (after 1995)

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Home / Featured / Kent Wada and Christine Borgman Lead Data Governance Task Force

KENT WADA AND CHRISTINE BORGMAN LEAD DATA GOVERNANCE TASK FORCE

February 10, 2015 by Stefanie Pietkiewicz

Kent Wada and Christine Borgman

- How should UCLA collect, organize, and use research analytics about our community?
- Who should have access to these data?
  - Within UCLA?
  - In partnership with public and private entities?
- What are the governance principles?
- What are the governance processes?

https://ccle.ucla.edu/course/view/datagov

Attribution of data

- Legal responsibility
  - Licensed data
  - Specific attribution required
- Scholarly credit: contributorship
  - “Author” of data
  - Contributor of data to this publication
  - Colleague who shared data
  - Software developer
  - Data collector
  - Instrument builder
  - Data curator
  - Data manager
  - Data scientist
  - Field site staff
  - Data calibration
  - Data analysis, visualization
  - Funding source
  - Data repository
  - Lab director
  - Principal investigator
  - University research office
  - Research subjects
  - Research workers, e.g., citizen science…

For Attribution -- Developing Data Attribution and Citation Practices and Standards: Summary of an International Workshop. Washington, D.C.: The National Academies Press. 2012

Discovery and Interpretation

- Identify the form and content
- Identify related objects
- Interpret
- Evaluate
- Open
- Read
- Compute upon
- Reuse
- Combine
- Describe
- Annotate…

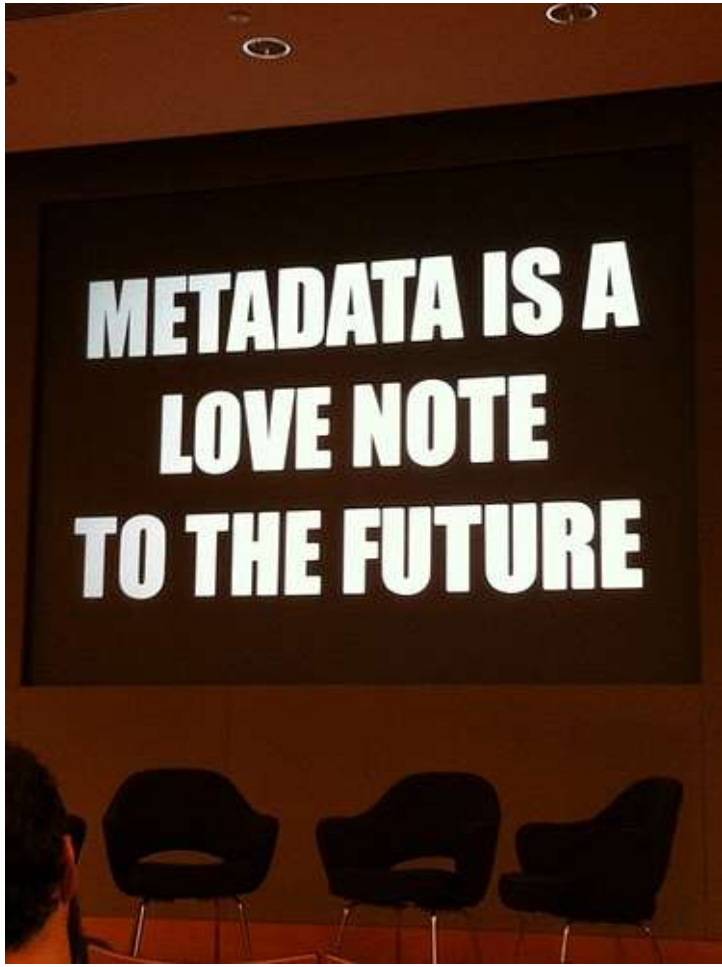
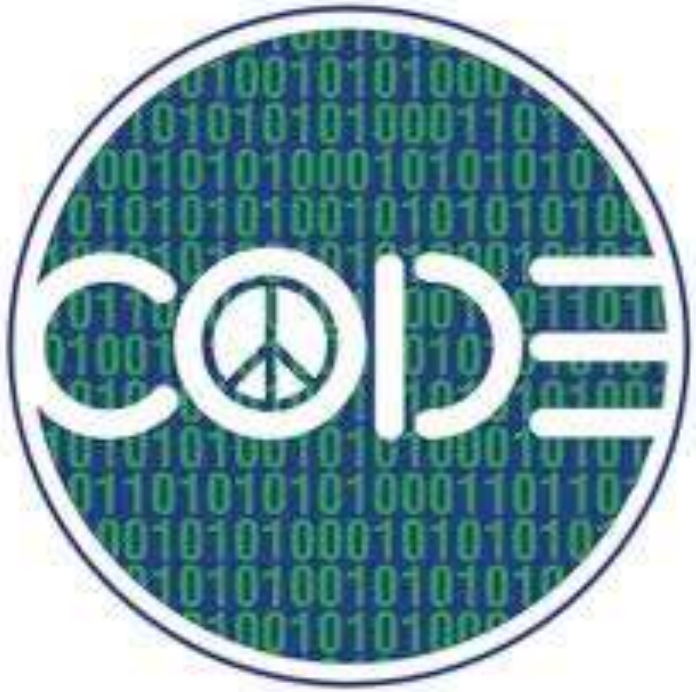


Photo by @kissane; presentation by Jason Scott (@textfiles)

Interpretation and replication

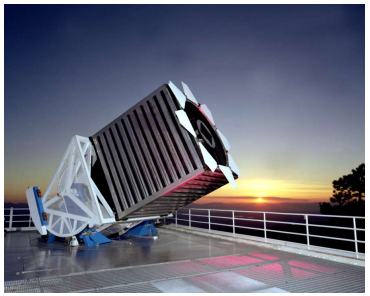
- Datasets
- Methods
  - Collection
  - Cleaning
  - Analysis
  - Codebook
- Publications
- Software and code
- Instrumentation

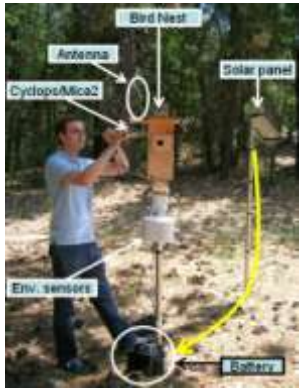


http://peacetour.org/sites/default/files/code4peace-logo2-v3-color-sm.jpg

Some ways to release data

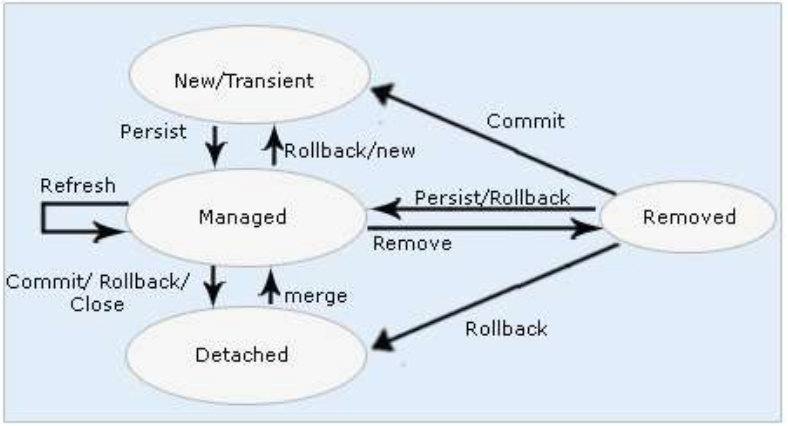
- Centralized data production
  - Top down investments in data
  - Common data archive
- Decentralized data production
  - Bottom up investments in data
  - Pool domain resources later
- Domain-independent aggregators
  - University repositories
  - Figshare, Dataverse, DANS…
- Post on lab / personal websites
- Share privately upon request





Identity and persistence

- Identity
  - Identifiers
    - DOI, Handles
    - URI, PURL…
  - Naming and namespaces
    - Authors/creators: ORCID, VIAF…
    - Generic/specific: registry number…
  - Description
    - Self-describing
    - Metadata augmentation
- Persistence
  - Perishable
  - Long-lived
  - Permanent



Persistence Content

http://web-interview-questions.blogspot.com/2010_06_21_archive.html

Intellectual property

- What can I do with this object?
- What rights are associated?
  - Reuse
  - Reproduce
  - Attribute
- Who owns the rights?
- How open are data?
  - Open data
  - Open bibliography

http://pzwart.wdka.hro.nl/mdr/research/lliang/mdr/mdr_images/opencontent.jpg/

MODERN DATA SCIENTIST

Data Scientist, the sexiest job of the 21th century, requires a mixture of multidisciplinary skills ranging from an intersection of mathematics, statistics, computer science, communication and business. Finding a data scientist is hard. Finding people who understand who a data scientist is, is equally hard. So here is a little cheat sheet on who the modern data scientist really is.

MATH & STATISTICS

- Machine learning
- Statistical modeling
- Experiment design
- Bayesian inference
- Supervised learning: decision trees, random forests, logistic regression
- Unsupervised learning: clustering, dimensionality reduction
- Optimization: gradient descent and variants

PROGRAMMING & DATABASE

- Computer science fundamentals
- Scripting language e.g. Python
- Statistical computing packages, e.g., R
- Databases: SQL and NoSQL
- Relational algebra
- Parallel databases and parallel query processing
- MapReduce concepts
- Hadoop and Hive/Pig
- Custom reducers
- Experience with xaaS like AWS

DOMAIN KNOWLEDGE & SOFT SKILLS

- Passionate about the business
- Curious about data
- Influence without authority
- Hacker mindset
- Problem solver
- Strategic, proactive, creative, innovative and collaborative

COMMUNICATION & VISUALIZATION

- Able to engage with senior management
- Story telling skills
- Translate data-driven insights into decisions and actions
- Visual art design
- R packages like ggplot or lattice
- Knowledge of any of visualization tools e.g. Flare, D3.js, Tableau

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Marketing DISTILLERY

https://github.com/okulbilisim/awesome-datascience

Data Curation and Stewardship

- Services and tools
- Data management planning
- Selection and appraisal
- Metadata, provenance
- Migration
- Economics
- Infrastructure

http://www.librarygirl.net/2013/08/putting-your-best-foot-forward-tl.html

Reuse across place and time

- Reuse by investigator
- Reuse by collaborators
- Reuse by colleagues
- Reuse by unaffiliated others
- Reuse at later times
  - Months
  - Years
  - Decades
  - Centuries

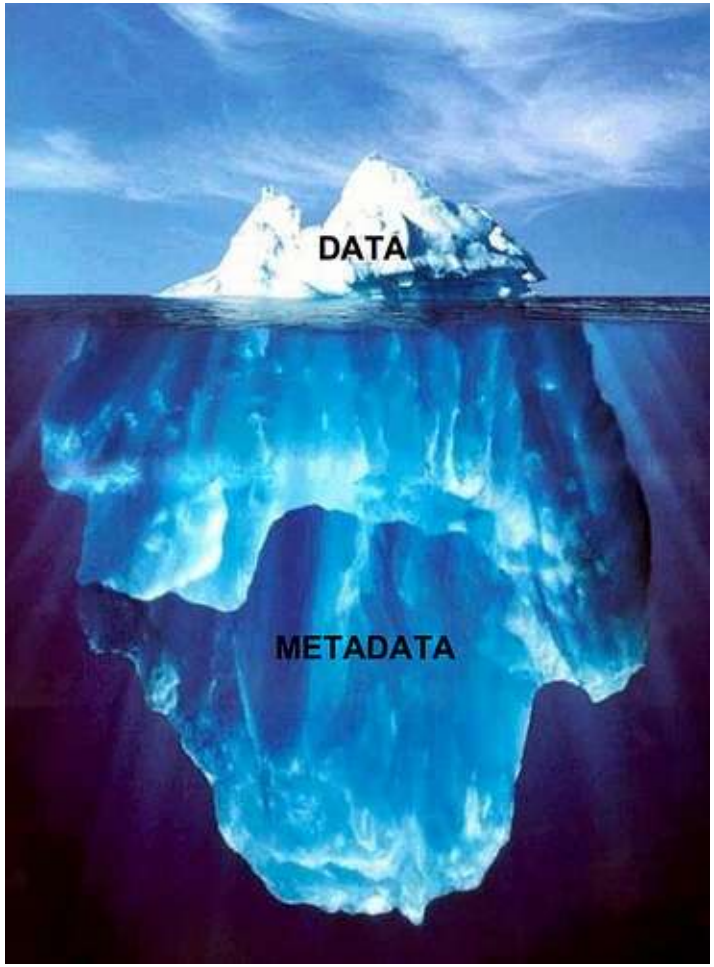
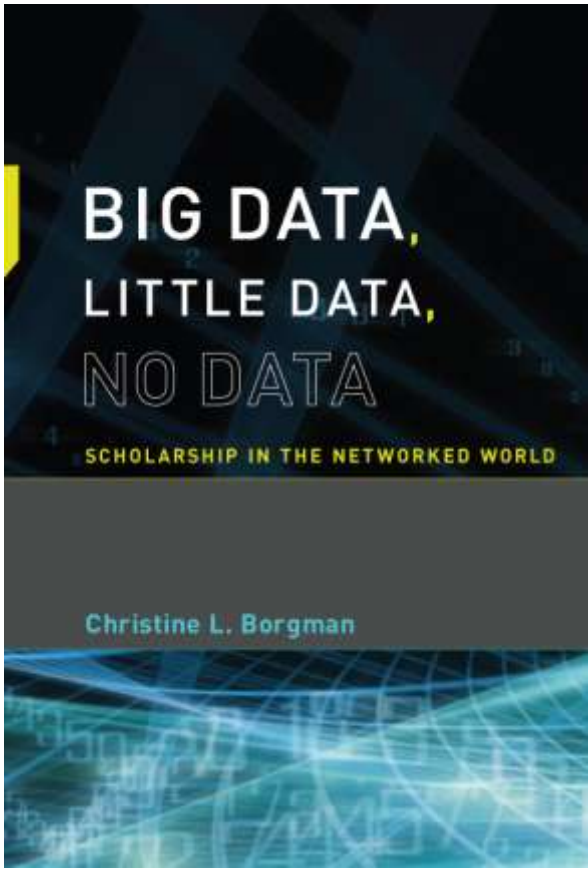


Image from Soumitri Varadarajan blog. Iceberg image © Ralph A. Clevenger. Flickr photo

http://knowledgeinfrastructures.org

Big Data, Little Data, No Data: Scholarship in the Networked World

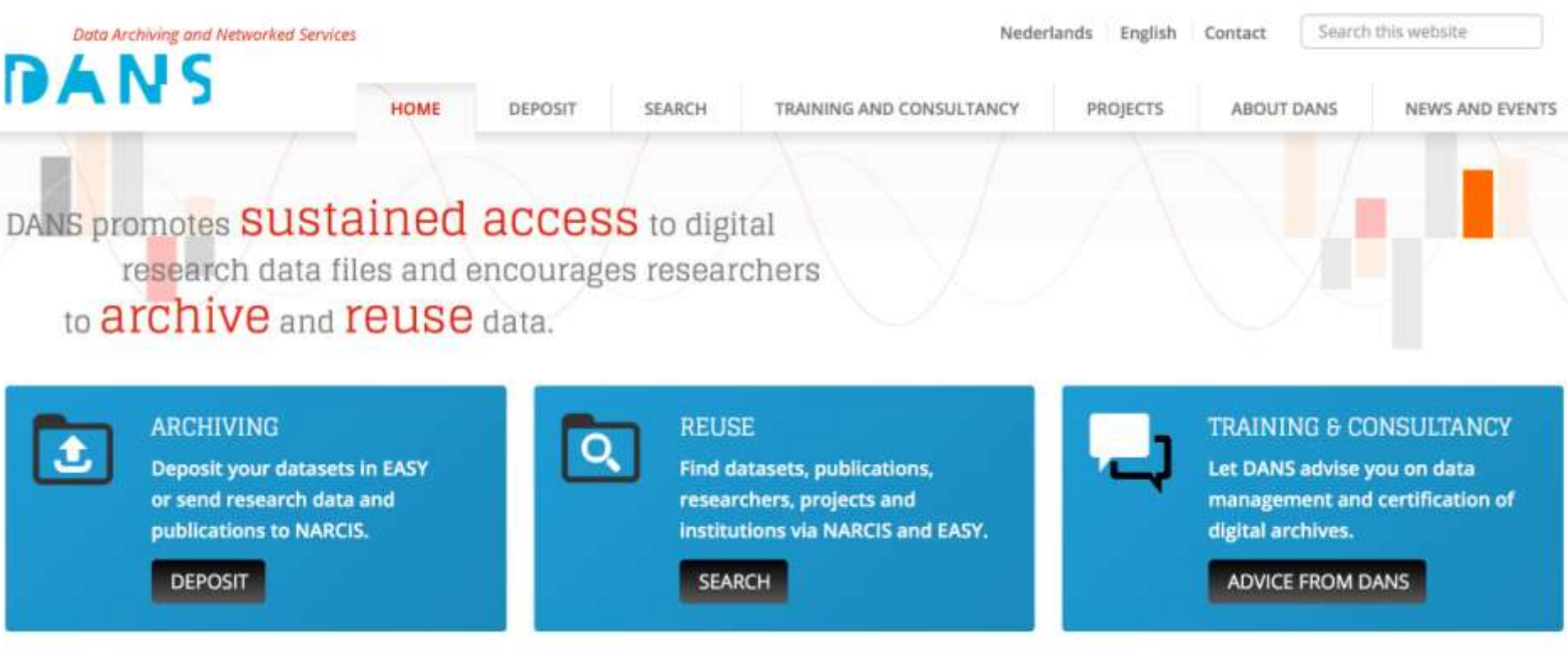
- Part I: Data and Scholarship
  - Ch 1: Provocations
  - Ch 2: What Are Data?
  - Ch 3: Data Scholarship
  - Ch 4: Data Diversity
- Part II: Case Studies in Data Scholarship
  - Ch 5: Data Scholarship in the Sciences
  - Ch 6: Data Scholarship in the Social Sciences
  - Ch 7: Data Scholarship in the Humanities
- Part III: Data Policy and Practice
  - Ch 8: Releasing, Sharing, and Reusing Data
  - Ch 9: Credit, Attribution, and Discovery
  - Ch 10: What to Keep and Why



If Data Sharing is the Answer, What is the Question?

- Alfred P. Sloan Foundation, 1 July 2015 to 30 June 2018; Joshua Greenberg, Program Officer
- UCLA Information Studies, Christine Borgman, Principal Investigator; Peter Darch, Ashley Sands, Irene Pasquetto, Milena Golshan, Bernadette Randles
- **Project Goal**
  - The project will develop new models of scientific data practices that will inform science policy, practice, and the design of knowledge infrastructures.
- **Objectives**
  - Our objectives are to identify how disciplinary configurations, scale, and methods of data collection influence the circulation of data. Our findings will assist multiple stakeholders in improving the transfer of data and knowledge between contexts, in developing and adopting appropriate tools and infrastructure, and in investing in the expertise necessary to leverage scientific data.

UCLA



- Questions
  - Who contributes data to DANS?
  - Who retrieves data from DANS?
  - What do people do with data from DANS?
  - What roles do archivists play in these processes?

- Investigators
  - Andrea Scharnhorst
  - Henk van den Berg
  - Christine Borgman
  - Andrew Treloar
  - Herbert van de Sompel

Acknowledgements

UCLA Data Practices team

*Peter Darch, Milena Golshan, Irene Pasquetto, Ashley Sands, Sharon Traweek, Camille Mathieu

*Former members: Rebekah Cummings, David Fearon, Ariel Hernandez, Elaine Levia, Jaklyn Nunga, Rachel Mandel, Matthew Mayernik, Alber[illegible], Patricia Smith, [illegible]n Wallis, Laura [illegible] Zhang

*Research funding: National Science Foundation, Alfred P. Sloan Foundation, Microsoft Research, DANS-Netherlands

*University of Oxford: Balliol College, Oliver Smithies