

Transforming Research and Education in the 21st Century The Role of Open Access

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Outline

1. The Research and Education (R&E) Enterprise needs to be transformed, so that it can be both sustainable and responsive to the needs of society
2. Open Access as a transformative and disruptive technology is a central part of this transformation
3. Open Access supports the core competencies that students and citizens need in the 21st century (to navigate, authenticate, integrate, innovate)
4. To achieve these goals we need to “open” several closed boxes (silos) in the current R&E landscape
5. This leads to a more inclusive interpretation of Open Access

At Berlin 9 in Washington, DC

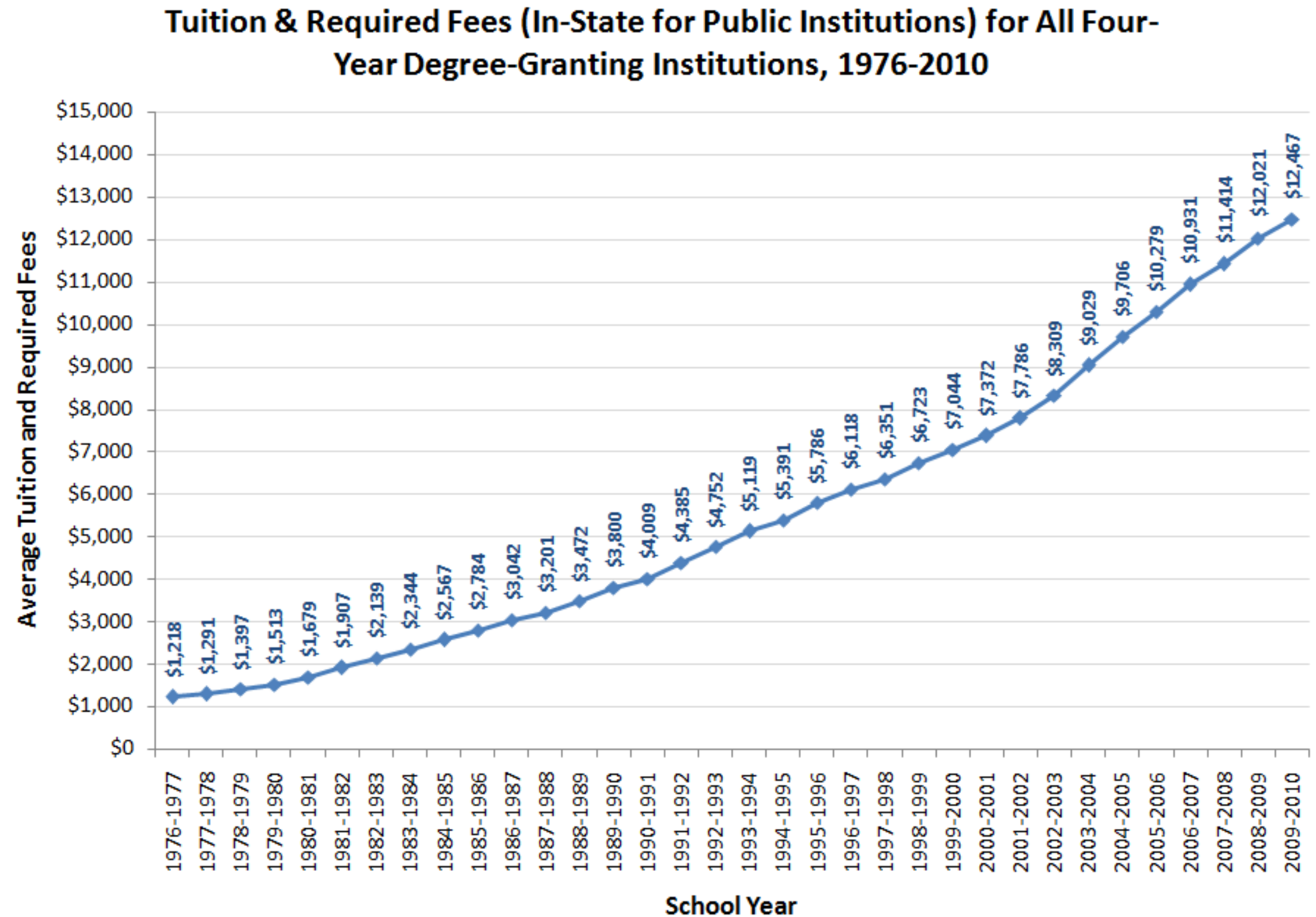
“We define excellence not by whom we exclude, but by whom we manage to include.”



Michael Crow
ASU President

Design Imperative of the New American University Model

Challenges to the Research and Education Enterprise



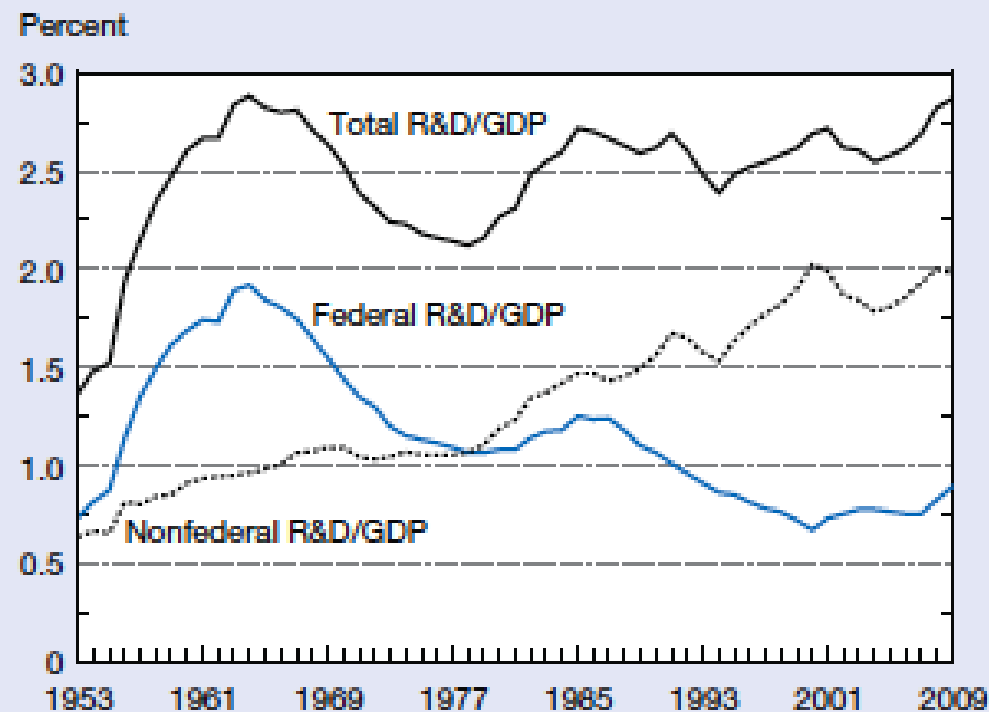
Source: Digest of Education Statistics: 2010

© Political Calculations 2012

Per Unit Costs of Education are Reaching Unsustainable Levels

Challenges to the Research and Education Enterprise

Figure 4-2
Ratio of U.S. R&D to gross domestic product, roles of federal and nonfederal funding for R&D: 1953–2009



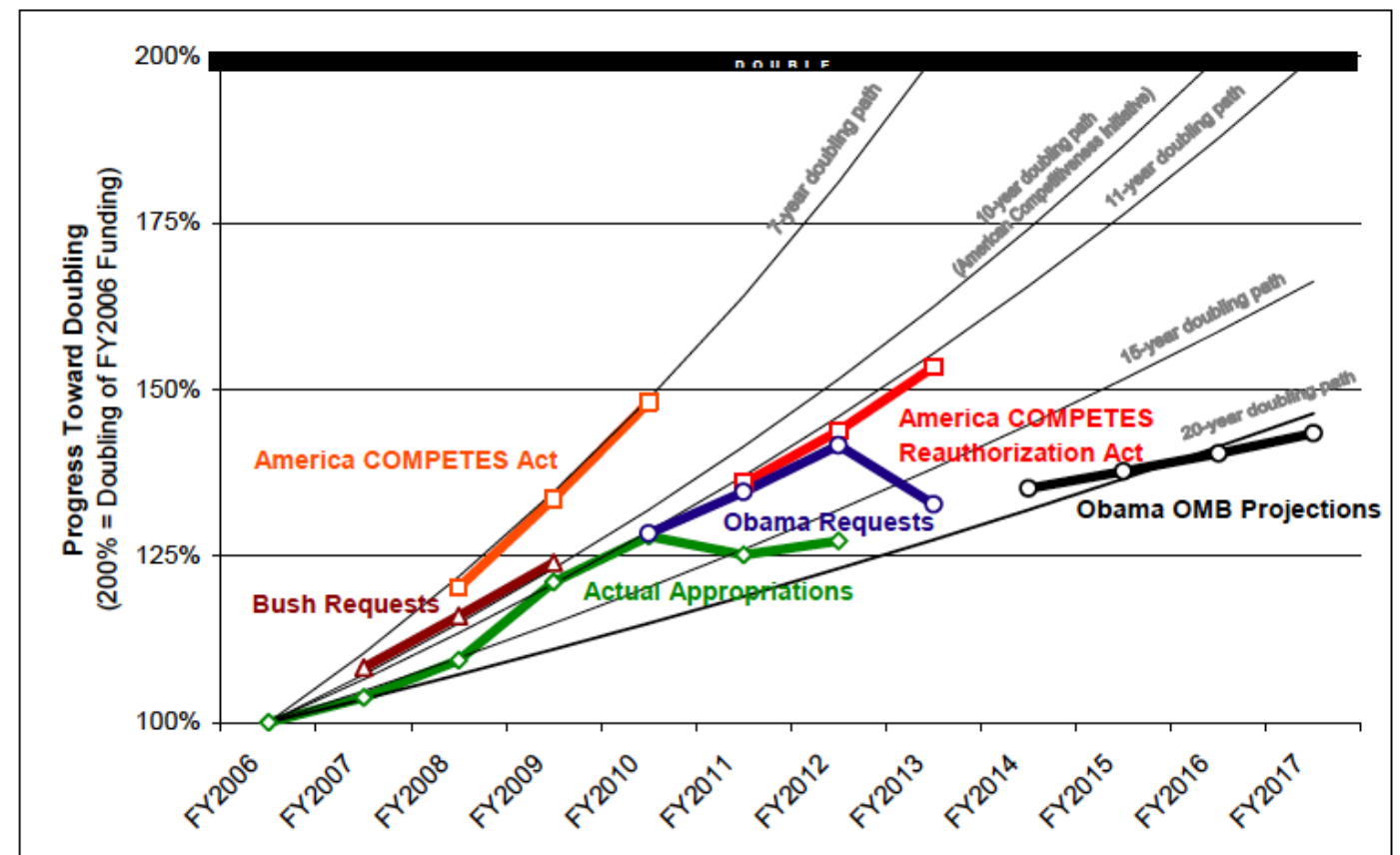
GDP = gross domestic product

NOTES: Some figures involve estimates and may later be revised. Federal R&D/GDP ratios represent the federal government as a funder of R&D by all performers; the nonfederal ratios reflect all other sources of R&D funding.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series).

Science and Engineering Indicators 2012

Figure I. Doubling of Research Funding for Targeted Accounts: Appropriations and Authorizations Versus Selected Rates



Decreasing Research Funding (in the US and other countries) in spite of ever increasing Costs of Research

Challenges to the Research and Education Enterprise

Additional Challenges

- => Disappearing traditional Career Paths for Ph.D. students in both Sciences and Humanities
- => A R&E “business model” that requires an unsustainable number of Ph.D. students and post-docs, leading to “lost generations”
- => Curricula that still perpetuate disciplinary traditions, while real world problems require trans-disciplinary approaches

THERE IS WIDESPREAD AGREEMENT THAT THE R&E ENTERPRISE IS IN NEED OF URGENT TRANSFORMATION

What is the role of Open Access in the Transformation of the R&E Enterprise?



Joseph Schumpeter

The internet as a disruptive technology

Challenges related to the internet today

=> Signal to Noise Ratio

=> Increasing commercialization

=> Emerging Monopolies

Open Access is needed to again disrupt the emerging patterns of an increasingly commercial and “closed” internet and to improve the signal to noise ratio

If Open Access is directed towards a broad public, what skills do people need to take advantage of it?

Core Competencies of Students and Citizens in the 21st Century

1. Navigate

2. Authenticate

3. Integrate

4. Innovate

What impediments to we have to overcome to teach and apply these core competencies?

Disciplinary Entrenchment

Outdated and Constrained Infrastructure

Wrong Incentive Structure

Misleading Expectations

Overcoming these challenges leads to a broader conception of OA

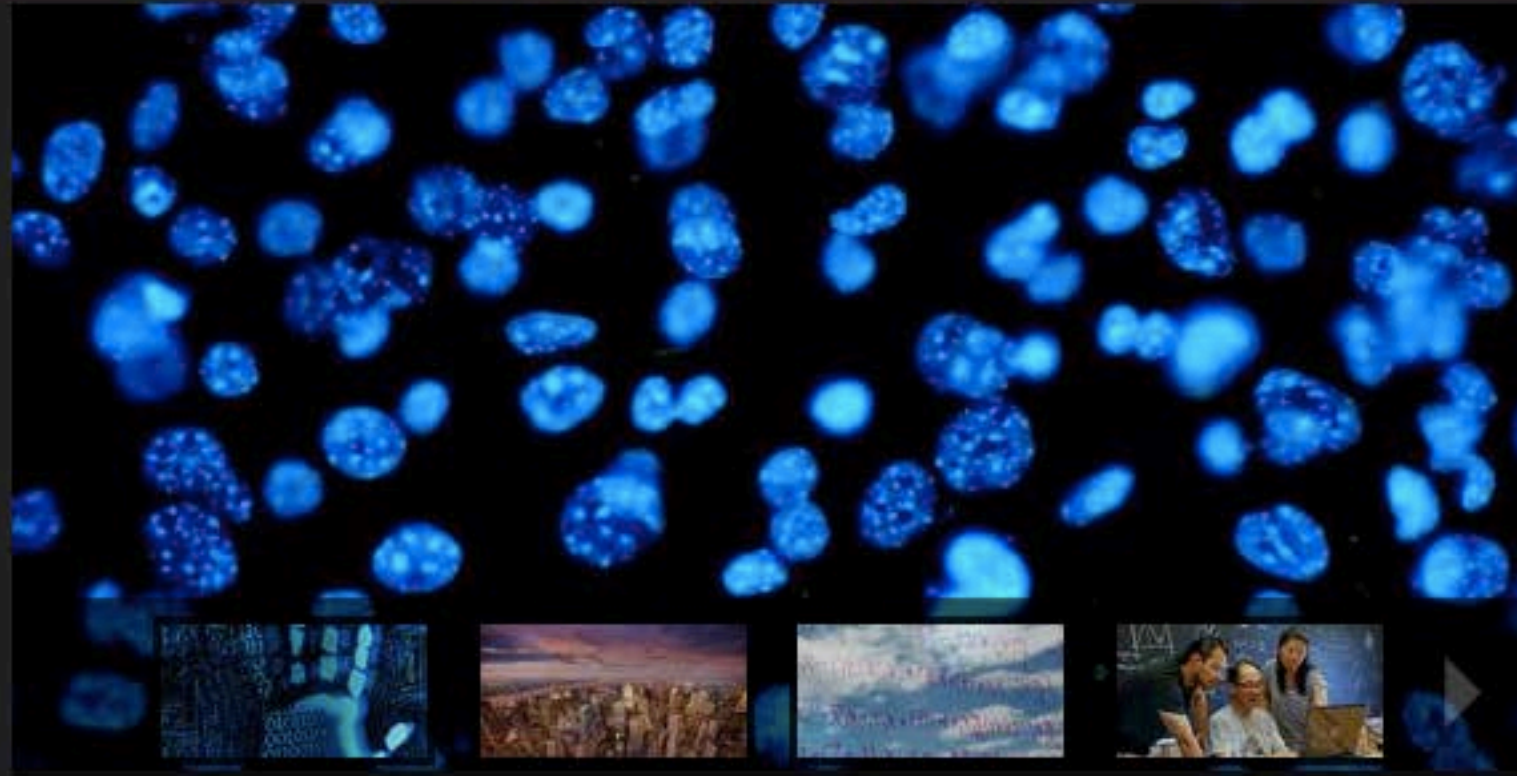
“Traditional” OA is essential in overcoming these challenges

Breaking Down Disciplinary Silos



SANTA FE INSTITUTE

Science for a Complex World



SFI NEWS

Audio: Emergence is happening all around us, and not just in nature

On the podcast/radio show Big Picture Science, SFI Research Fellow Simon DeDeo explains how and why emergence abounds not only in nature, but also in human social systems. ... [More](#)

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PUBLIC EVENTS

TBA

12.11.13 Seminar
12:15 p.m. Collins Conference

RESEARCH THEMES

Physics and Computation of Complex Systems

Human Behavior, Institutions, and Social Systems

Living Systems: Emergence, Hierarchy, and Dynamics

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MEDIA

President's Welcome
Update
Bulletin
Annual Report

Addressing Real World Problems

Climate Action: Who Will Lead?



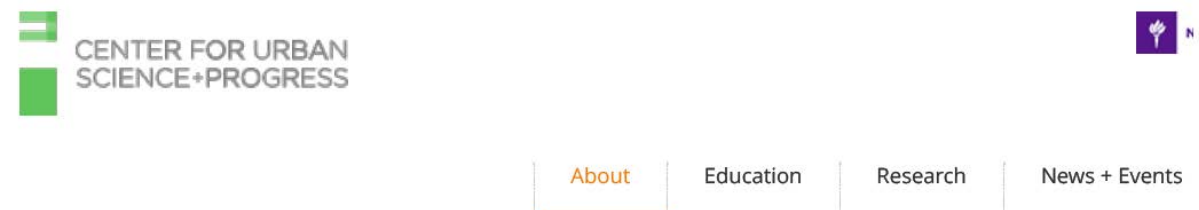
By Chris Spence



Thought Leader Series

Institute at the Golden Gate director says parks can spark bottom-up change | [read more](#)

Emerging Transdisciplinary Research Fields



USP
And Why CUSP Came To Be



THE NEW SCIENCE
OF CITIES

MICHAEL BATTY



Stiftung Mercator

Centres Science and Humanities Global Classroom

Global Classroom



Arizona State University Old Main

Stiftung Mercator is funding a “global classroom” at Leuphana University in Lüneburg and at Arizona State University (ASU). The project gives 20 students from each year at Leuphana and 20 students from each year at ASU the chance to learn how to pursue joint academic work in two parallel courses as part of a “comprehensive studies programme”. Educationally speaking, the project is based on the concept of “curriculum reform”, and aims to improve studies and teaching. In the spirit of learning through research, the project allows students to jointly compile academic papers or, for example, a textbook on the subject of sustainability, with the help of a virtual and at times real “global classroom”.

Globalized Education beyond the MOOC



The Embryo Project Encyclopedia

Recording and contextualizing the science of embryos, development, and reproduction.

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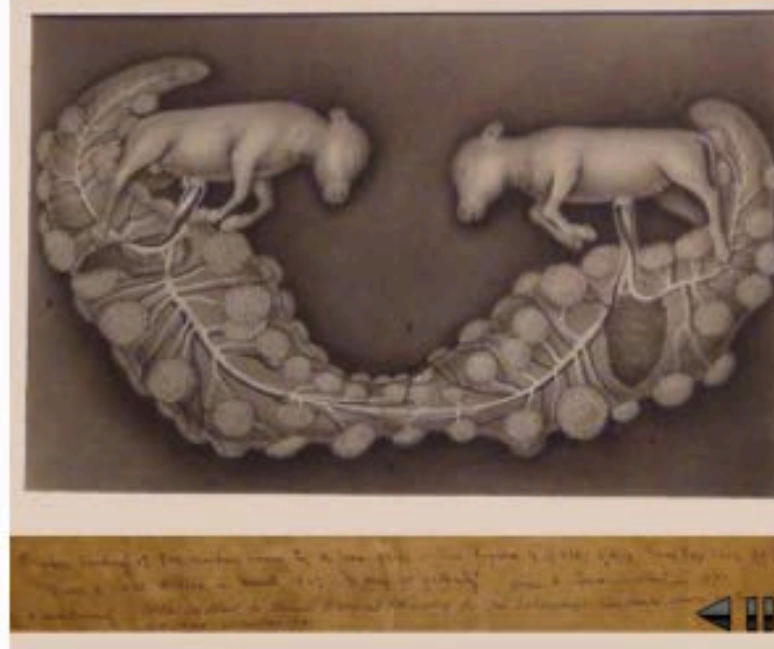
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F. R. Lillie's Diagram of Freemartins

Original Painting of Freemartin Twins by K. Toda (1916) -- See Figure 4 (p 426) Lillie Jour Exp Zool. 23 (1917) / Given to B. H. Willier in March 1937 "To keep for posterity". Given to James D. Ebert in 1971. / "Wash Drawing" Given by Ebert to the Marine Biological Laboratory for the Laboratory's Rare Room in the Lillie / Building, December 1991.

[Read more](#)

Newsroom

The new Embryo Project Encyclopedia website launched in April 2013 in its third iteration since 2007, replacing the 2009 version. It is a collaboration between Arizona State University and the Marine Biological Laboratory in Woods Hole, Massachusetts.

[All News](#)

Events

- April 26 Joint Atlantic Seminar for the History of Biology

[All Events](#)

What's New?

- Rosalind Elsie Franklin (1920-1958)
- J. B. v. M. B. (2001)
- Endoderm
- Germ Layers

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The Embryo Project is supported by the National Science Foundation, Arizona State University, Center for Biology and Society, the Max Planck Institute for the History of Science in Berlin, and the MBL WHOI Library.



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ARIZONA STATE UNIVERSITY

MBL

Biological Discovery in Woods Hole

Computational and Big Data History of Science

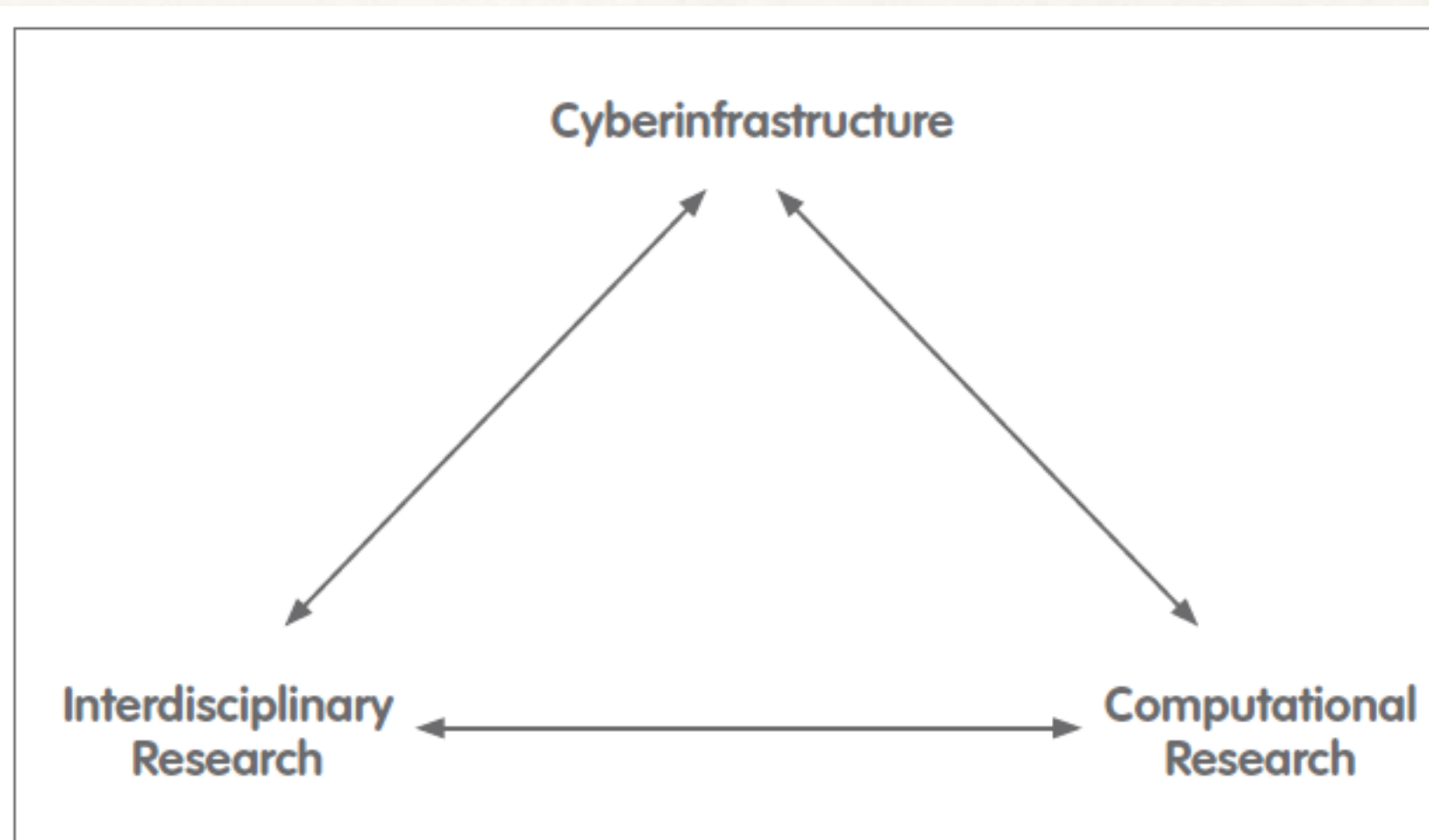
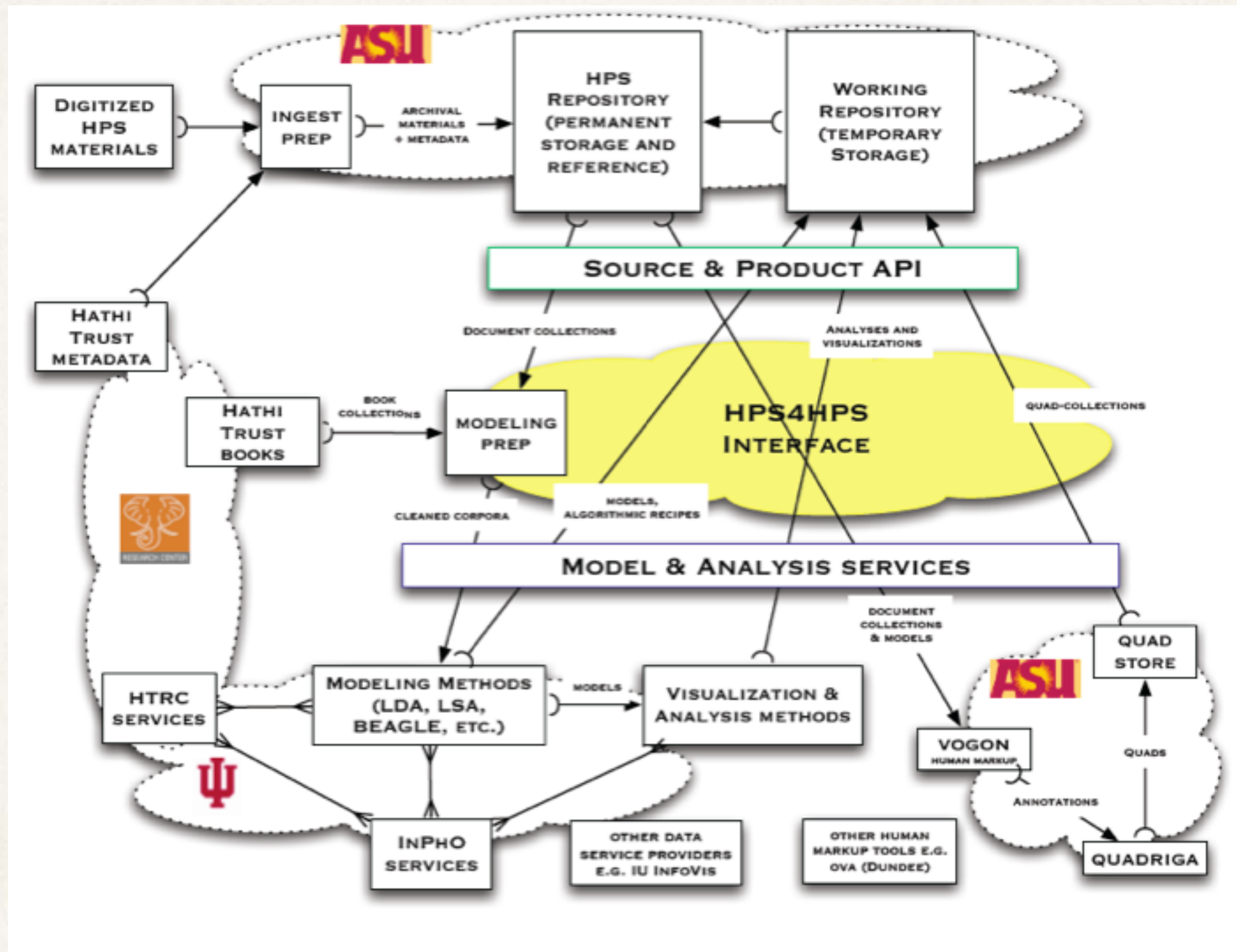


Figure 1: Advancing a comprehensive computational science program requires coordinated initiatives in developing and supporting interdisciplinary research, enabling cyberinfrastructure, and underlying research and culture in computation.

An Integrated, Collaborative and **OPEN** Research System



A Collaboration of ASU, Indiana University and the Max Planck Institute for the History of Science

Some Preliminary Results

**History of the Max Planck Society
Computational Analysis of the
Department Baldwin
MPI for Chemical Ecology, Jena**

Question: How can we assess the influence of a Research Program?

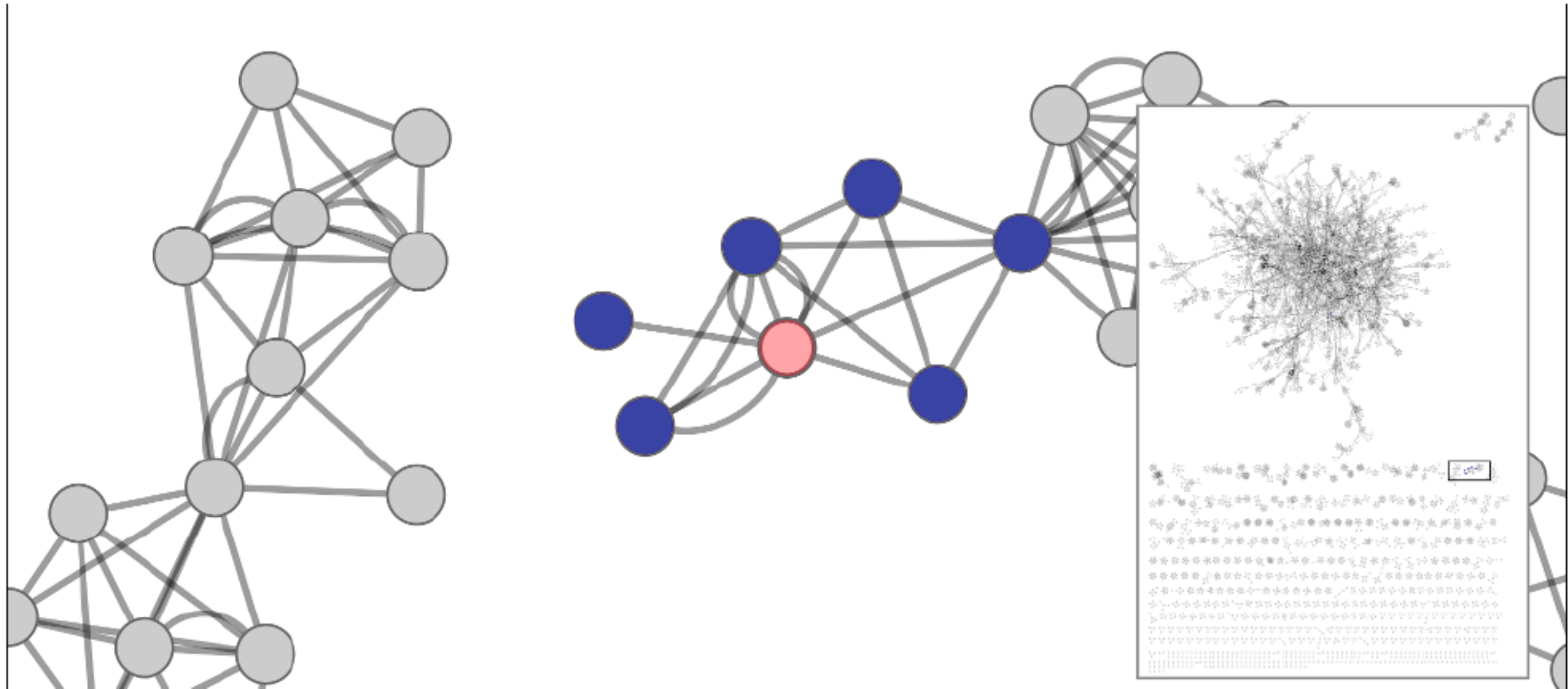


Figure 1. Coauthorship network from the journal *Plant Physiology*, 1999 - 2002 (inclusive). Ian Baldwin is represented by a red node, and his coauthors are represented as blue nodes. The whole graph is shown at right, and the focal region is boxed.

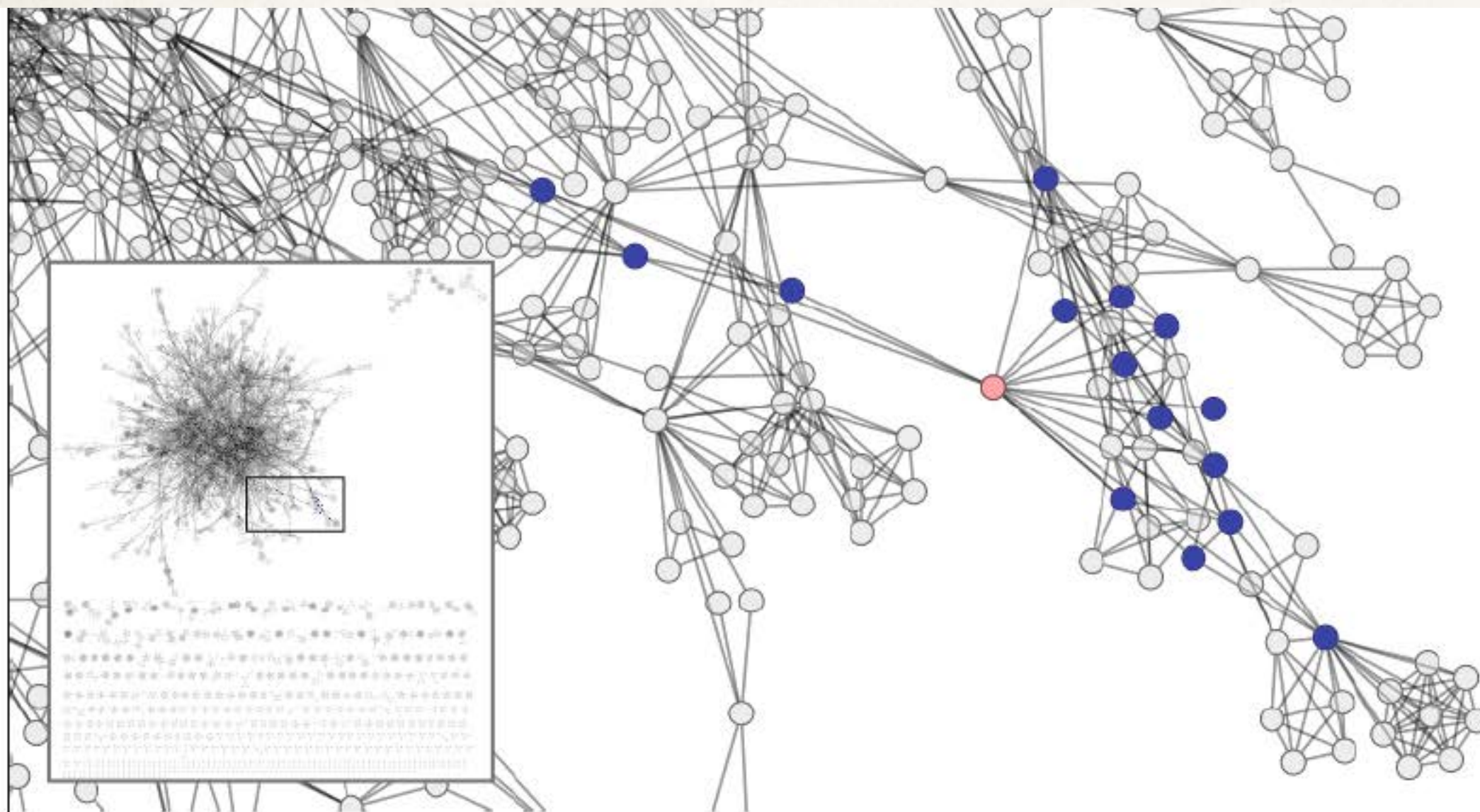


Figure 2. Coauthorship network from the journal *Plant Physiology*, 2000 - 2003 (inclusive). Ian Baldwin is represented by a red node, and his coauthors are represented as blue nodes. The whole graph is shown at left, and the focal region is boxed. Baldwin is now part of the main component, situated near the periphery.

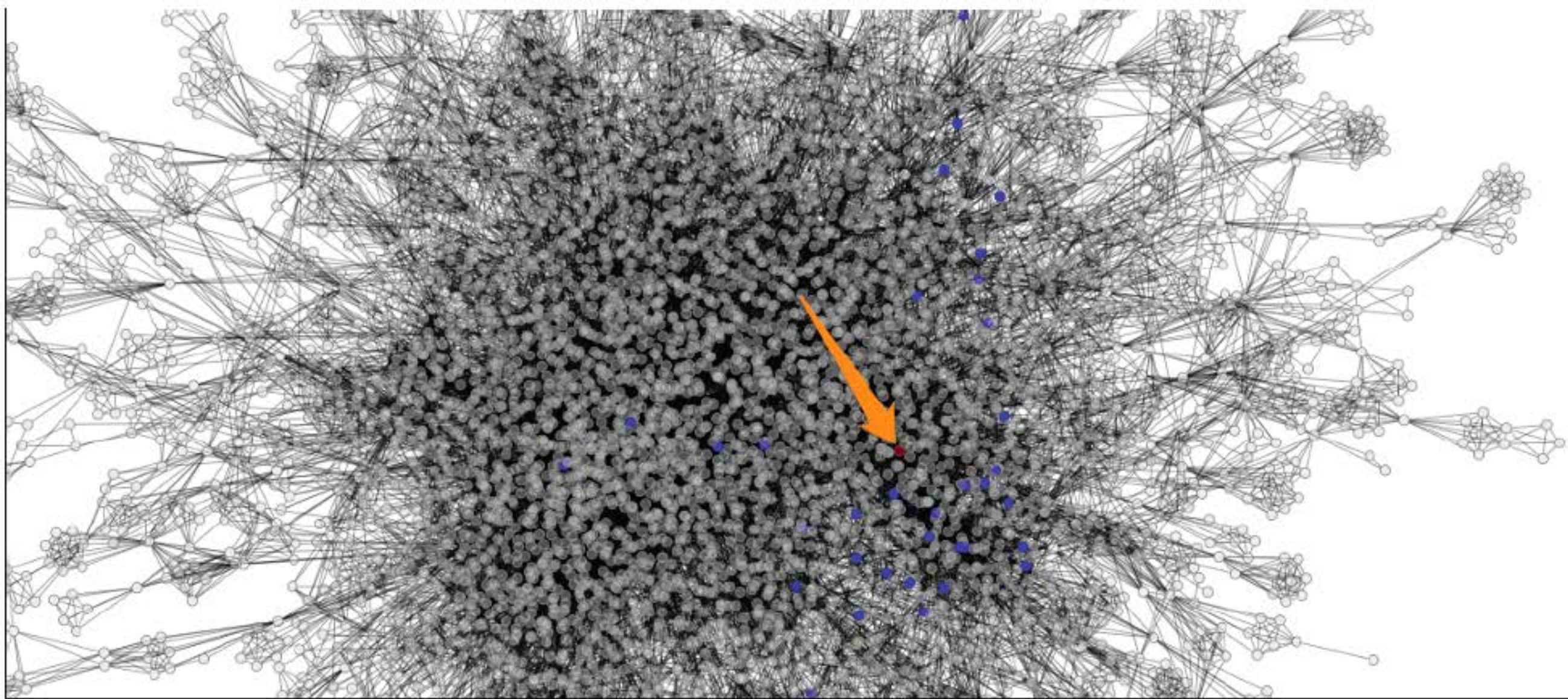


Figure 3. Coauthorship network from the journal *Plant Physiology*, 2007 - 2010 (inclusive). Ian Baldwin is represented by a red node, and his coauthors are represented as blue nodes.

A New Metric measuring the degree of collaboration

Closeness Centrality

$$c''(i) = \frac{\sum_k \frac{1}{d_{ik}}}{N} \quad (\text{eq. 3})$$

where k is the index of the k th node in the set of nodes in the same component as focal node i , and N is the total number of nodes in the network (all components).

This makes implementation in Python a breeze:

```
1 c = 0
2 for d in networkx.shortest_path_length(graph, i).values():
3     c += 1/float(d)
4 c = c/len(graph)
```

global_closeness Centrality.py hosted with ❤ by GitHub

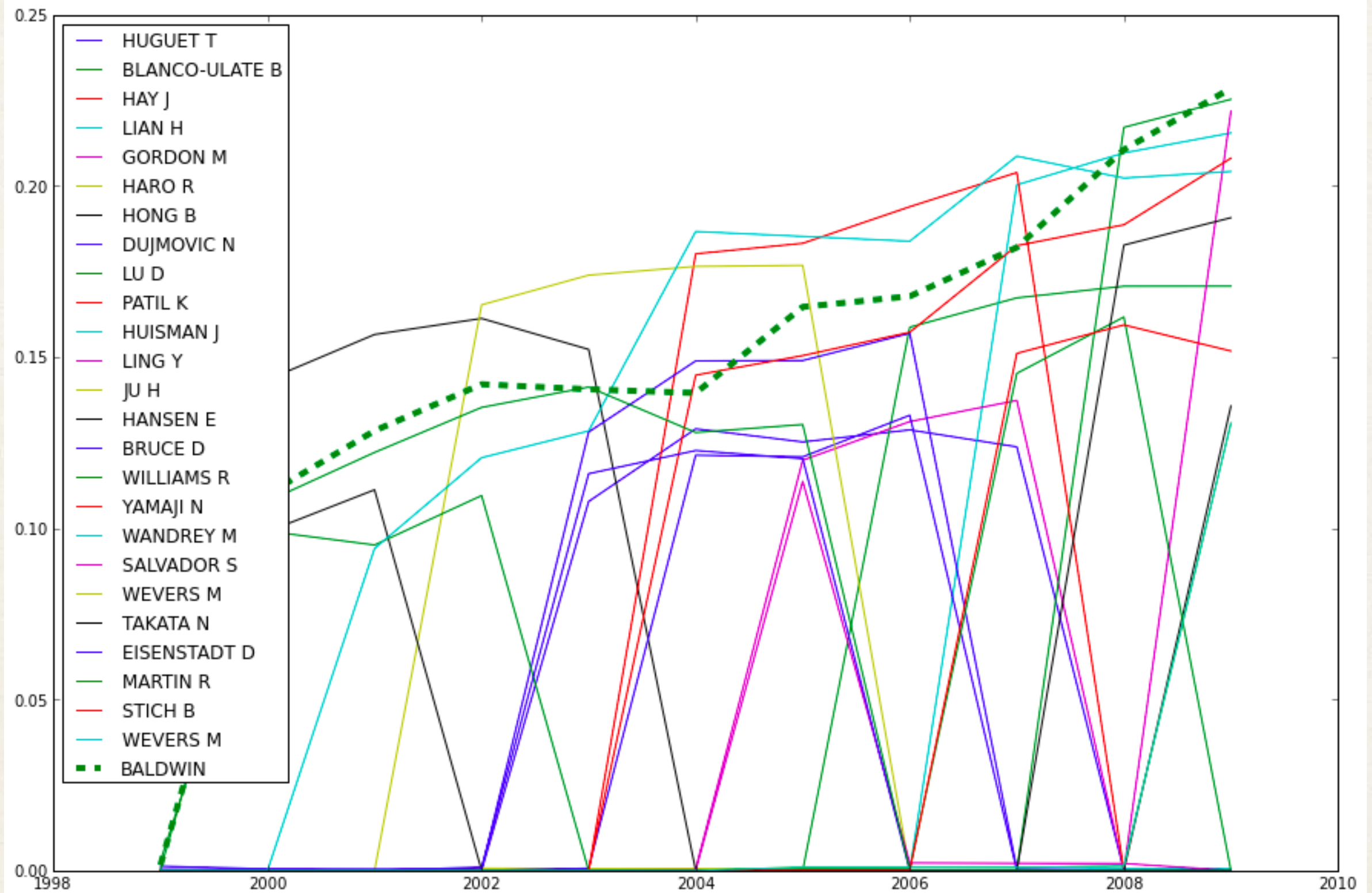
[view raw](#)

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global_closeness Centrality.py hosted with ❤ by GitHub

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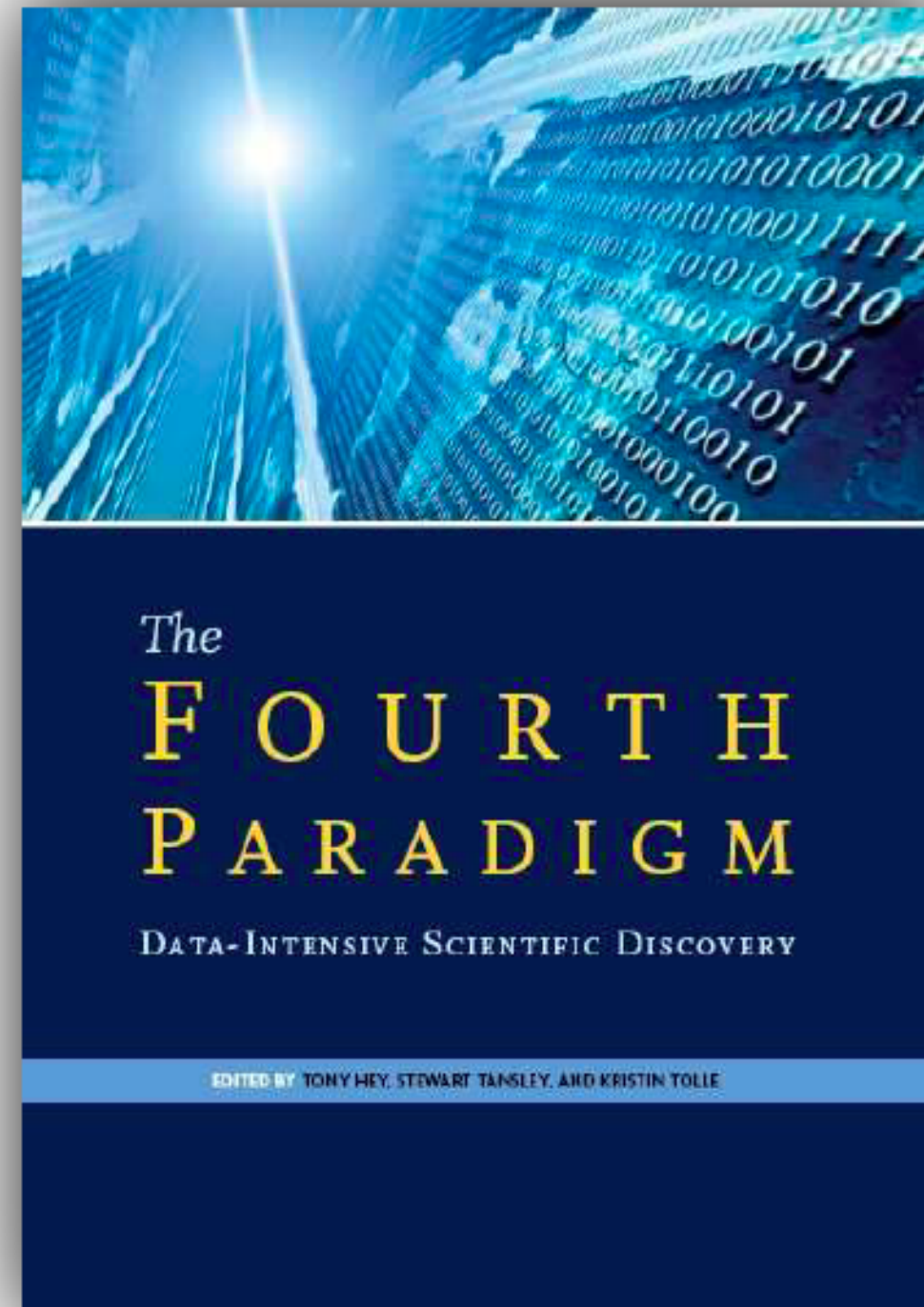
The Rise of a New Research Paradigm



Transforming Infrastructure

4th Paradigm Science

- A new method of pushing forward the frontiers of knowledge, enabled by new technologies for gathering, manipulating, analyzing and displaying data.
- Complementing **data-generating** science with **data-driven** science
- Ecumenical
 - Astronomy
 - Physics
 - Economics
 - Climate
 - Genomics
- Transdisciplinary

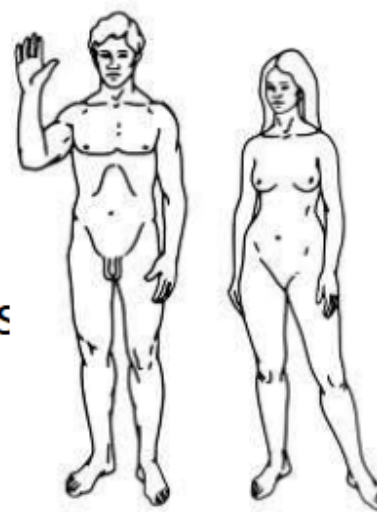
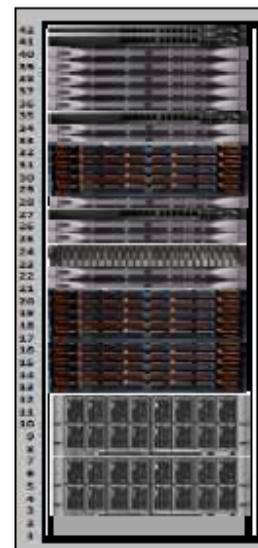


Next Generation Cyber Capability for Biomedical, Physical, Social Sciences and Humanities

OA (publication and data) is needed for this capability to reach its full potential

The NGCC Data Science “Instrument”- *an elemental whole composed of:*

- Physical Capacity
 - Ultra-high bandwidth Networks
 - Large-scale storage
 - Multiple “flavors” of computation
- Logical Capabilities
 - Software
 - Metadata
 - Semantics
- Human Resources
 - Transdisciplinary Teams



Real time consumer data

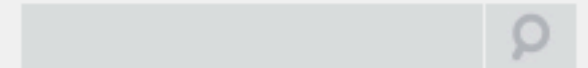


shipments of telehealth devices grow to about 2 million by 2013

Source: <http://mobihealthnews.com>



Research Data Sharing
without barriers



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Organisation

Working and Interest Groups

News & Events

Plenary Meetings

RDA in the Press

RDA is recruiting a Secretary General - Find out more!



Marine Data Harmonization IG

Status: Pending Action

The objective of this working group is to promote the development of a common global framework for the management of marine data to address the impact of natural and man-made phenomena. Multi-disciplinary collaboration and large volumes of good quality interoperable data which can be easily located and accessed is required for this to support the development of this ecosystem based approach to marine research.

Education and Skills on Data Science

Engagement Interest Group (EIG)

Global Names Architecture IG

Legal Interoperability IG

Long tail of research data IG

Marine Data Harmonization IG

Materials Data Infrastructure & Interoperability IG

Recent Working and Interest Group Activity

Nunaliit Project Share: Presentation abstract
Submitted by [Julia Collins](#) On 15, Nov 2013

Phone conference now
Submitted by [Rainer Stotzka](#) On 14, Nov 2013

test
Submitted by [Mark Parsons](#) On 08, Nov 2013

Agenda & Summary Slides of IG Session at 2nd Plenary Meeting 17th September 2013

News & Events



Research Data Alliance/US To Expand Reach and Scope With \$5 Million NSF Grant

Changing Incentives and Expectations

The Need for **Team Science** and the Difficulties of Young Researchers to Participate in These Projects

=> New Evaluation Metrics and Career Paths

=> Open Access and Open Evaluation

Examples: High Energy Physics, the New American University Experiment, etc.

Publishing Data and Getting Credit for it (see Research Data Alliance)

More fluidity between academia, industry, start-ups, cultural institutions, (new) media => a (new) and Global Enlightenment

Conclusion

“Traditional” OA is essential in overcoming these challenges

Overcoming these challenges will lead to an even broader conception of OA