

# Surviving Life as a Researcher

*Jacob Beal*

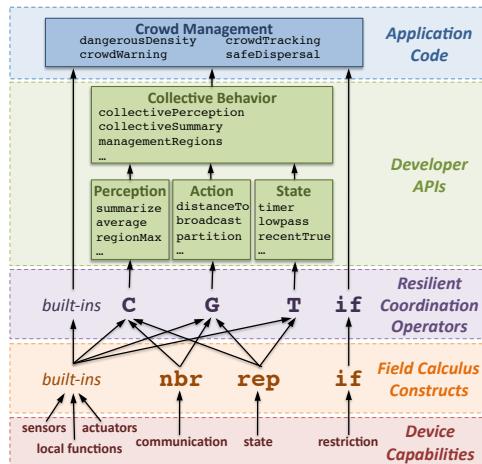
FAS\* Doctoral Symposium  
Augsburg, Germany  
September, 2016

**Raytheon**  
**BBN Technologies**

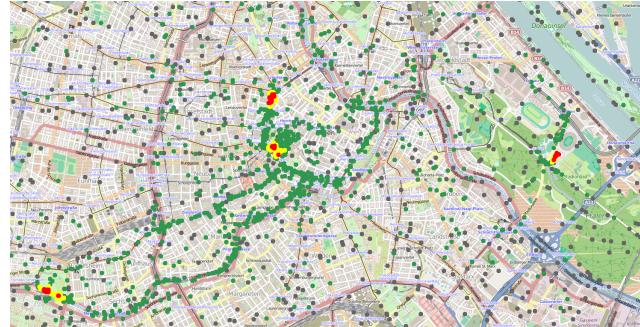
# Who am I, and what do I do?

## Aggregate Programming

Field Calculus, Spatial Computing



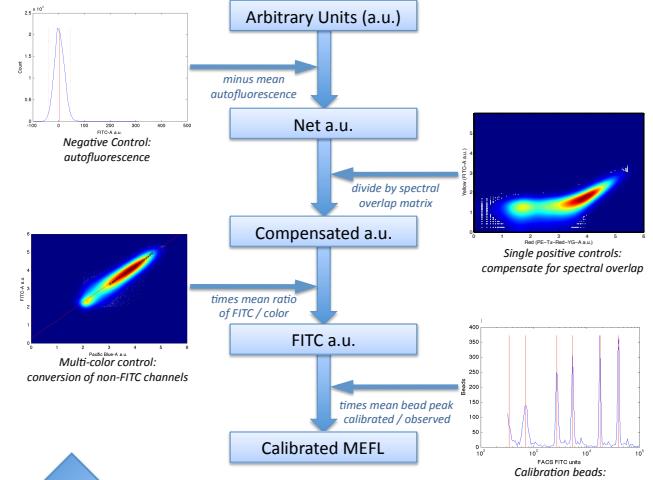
## Resilient Networking



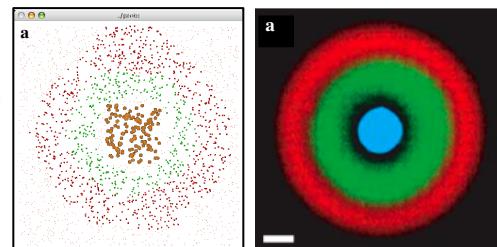
Beal et al., Computer, 2015,  
Beal & Bachrach, IEEE Int.Sys. 2006,  
Beal & Bachrach, SCW, 2008

## Synthetic Biology Analytics & Design

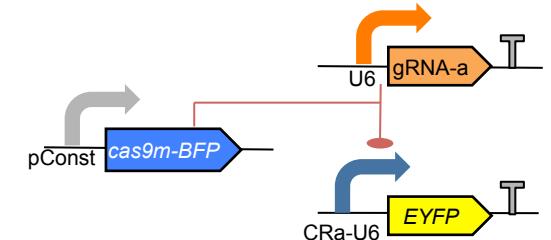
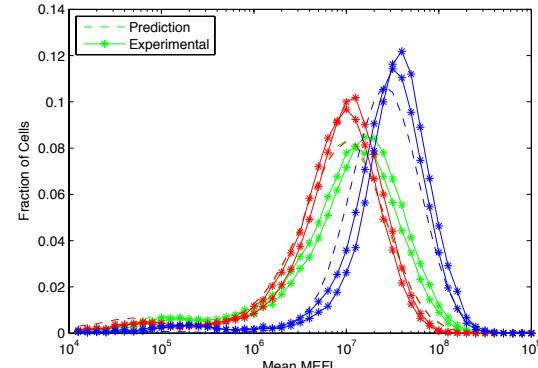
Calibrated Flow Cytometry



## Spatial Patterning



## Precision Organism Engineering High-Performance Devices



Kiani et al., Nat. Meth., 2014,  
Beal et al., ACS Syn.Bio., 2012,  
Beal et al., ACS Syn.Bio., 2014

# Why are we here today?

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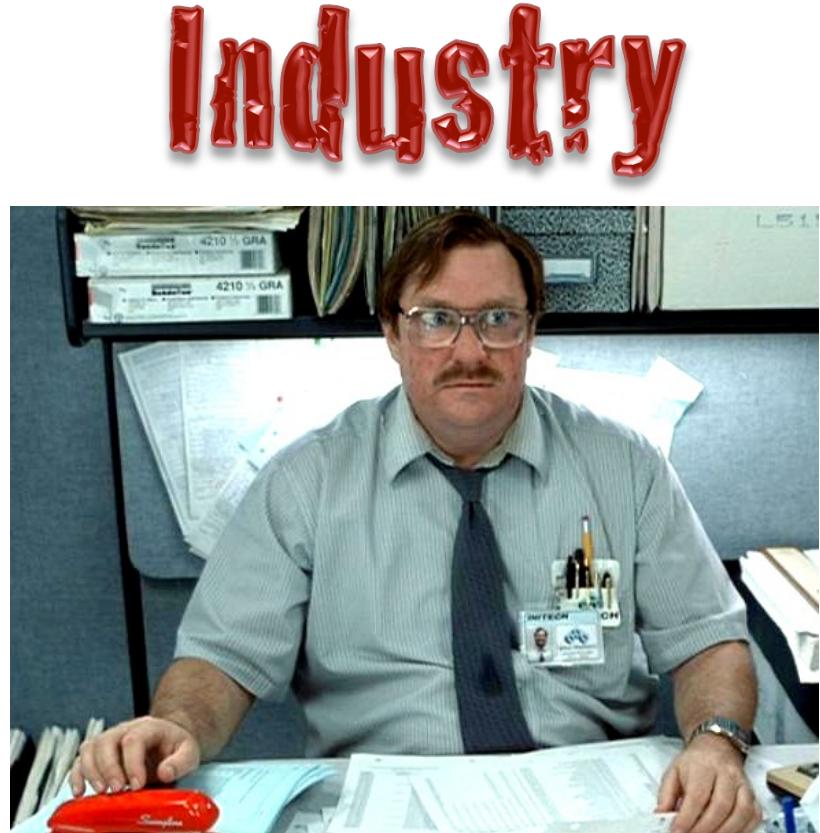
If I were a sensible man, I'd be home with my family



Researchers, artists, entrepreneurs → driven people

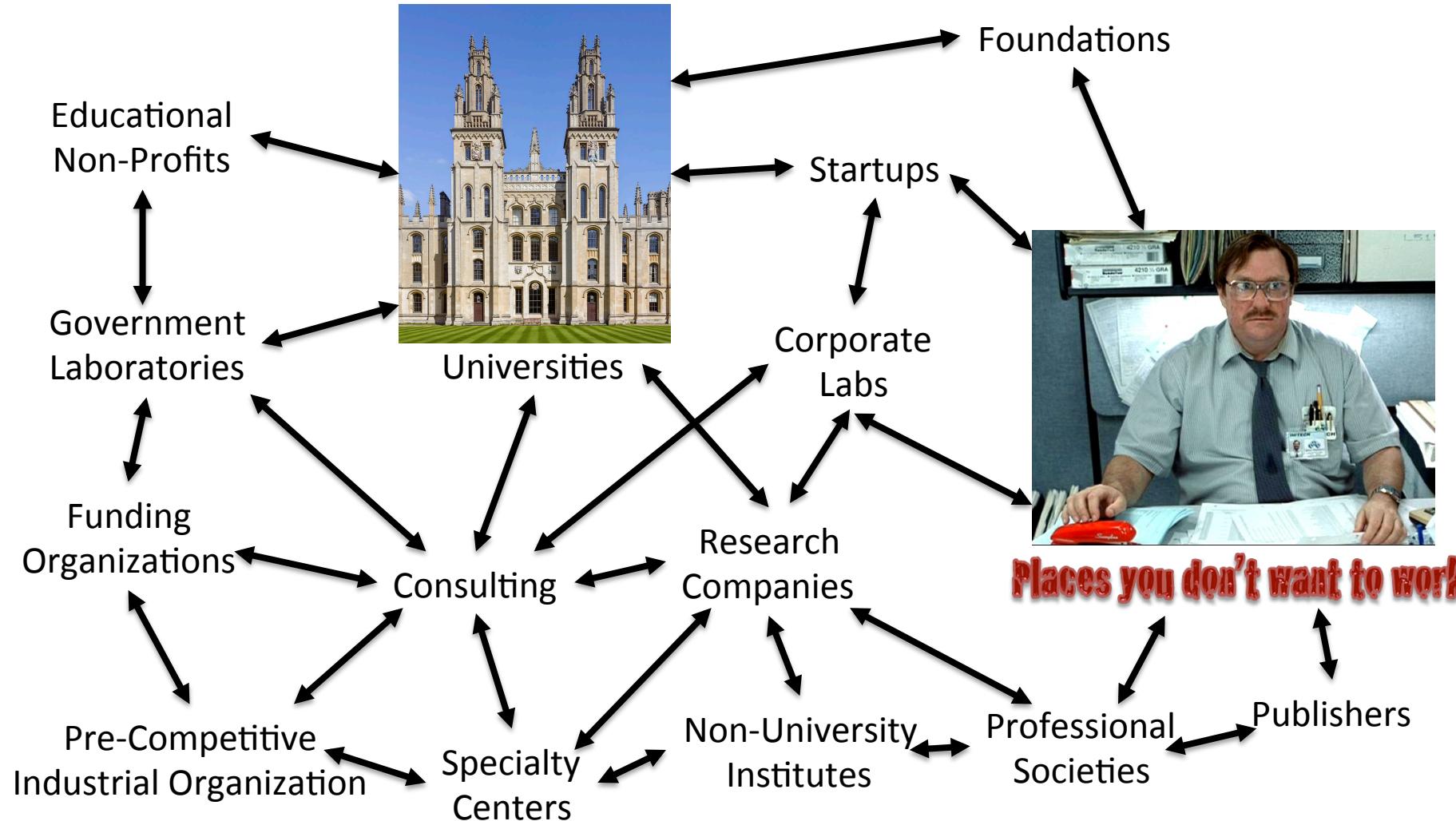
***What knowledge can help us survive and thrive?***

# The research ecosystem is complex



*The view from graduate school*

# The research ecosystem is complex

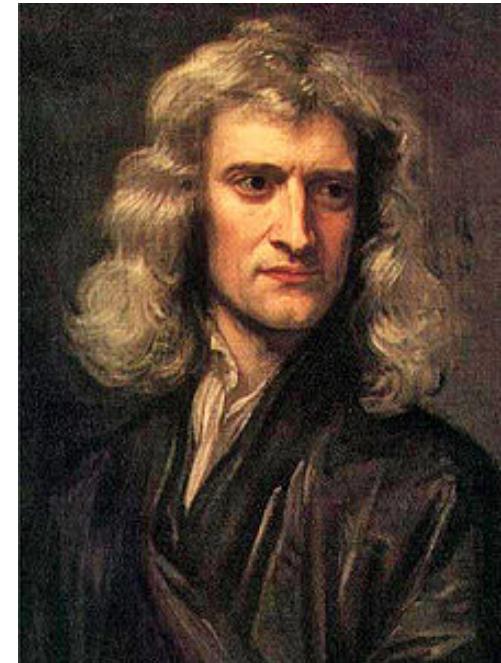
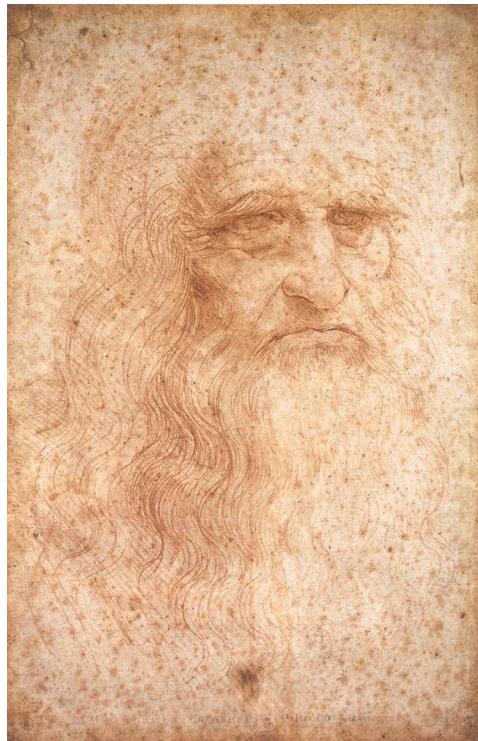


*Reality is much more complicated*

# The Renaissance Man is Dead

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Scientific mythology and ideals are still largely grounded in the era of “gentlemen scientists”



Our world is much faster, more complex, interconnected

# There are many niches for researchers



Mathematician



Administrator



Scholar



Educator



Hacker



Visionary



Iconoclast



Integrator

# Hamming: “You and Your Research”

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Why do some do great work, while others just as smart fail to?



Think great thoughts

Work hard on important problems

Look for generalization

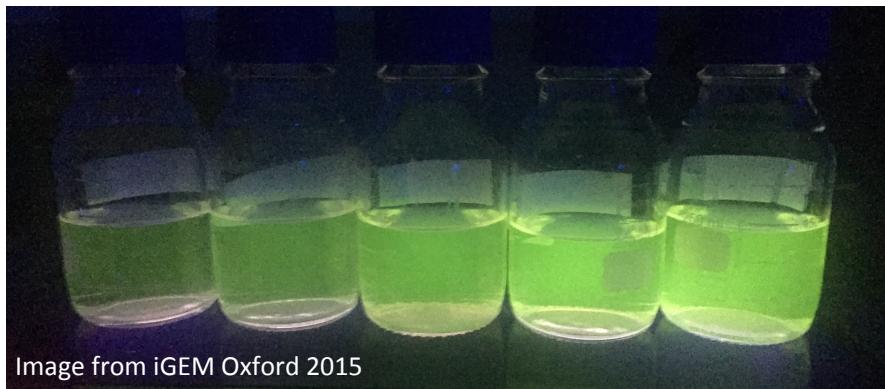
Work with your door open

It's OK to appear to conform

Learn to communicate

# My most important recent project

iGEM interlab study: organized 130 teams around the world to study a fundamental measurement problem in synthetic biology



- Massive community effort
- Critical results on a pressing problem
- Nobody funded it.
- Rejected by high impact → published in PLOS ONE
- Still making a big impact (we think)

# Your focus is likely to shift over time

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*"No matter what, we'll never be doing the same work 10 years from now. Either we will have succeeded and moved on, or else we will have failed and need to go try something different."*

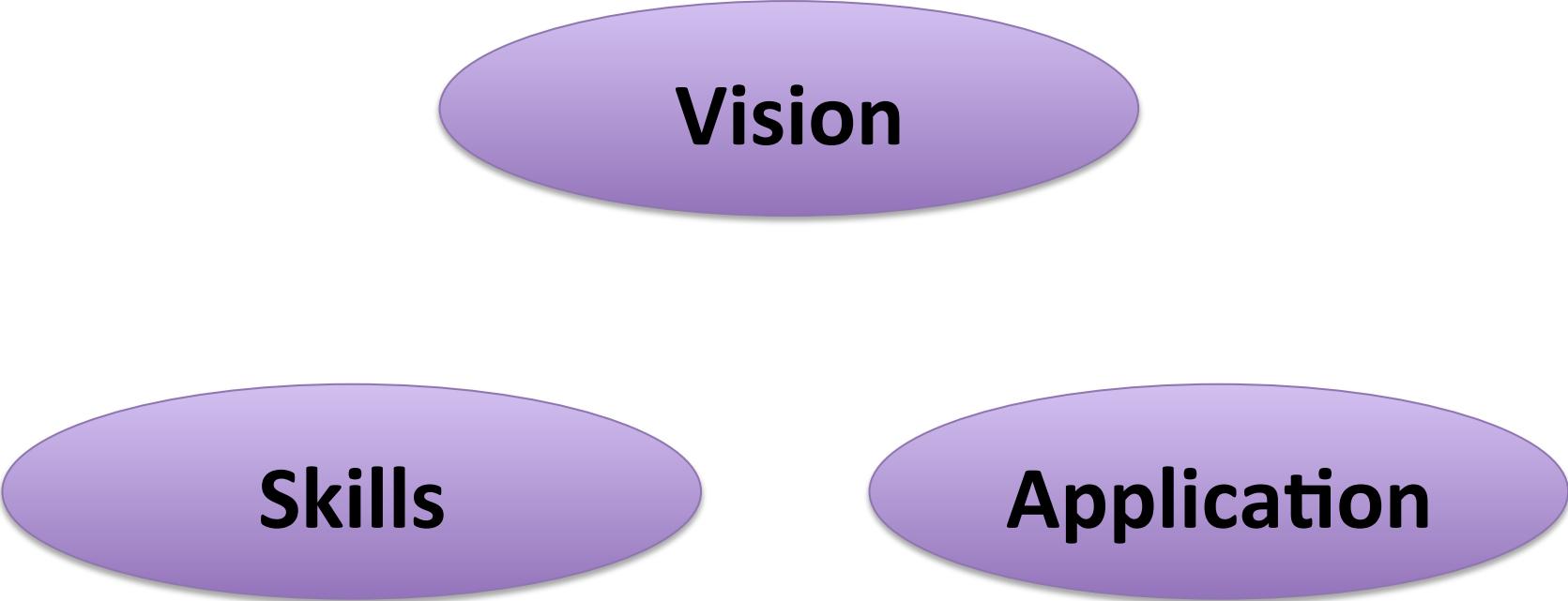
– Joe Loyall

My own history of technical ambition:

- 1995: Video game programming
- 2002: Human-level AI
- 2009: Spatial computing
- 2016: Synthetic biology, aggregate programming

# A Three-Way Pivot

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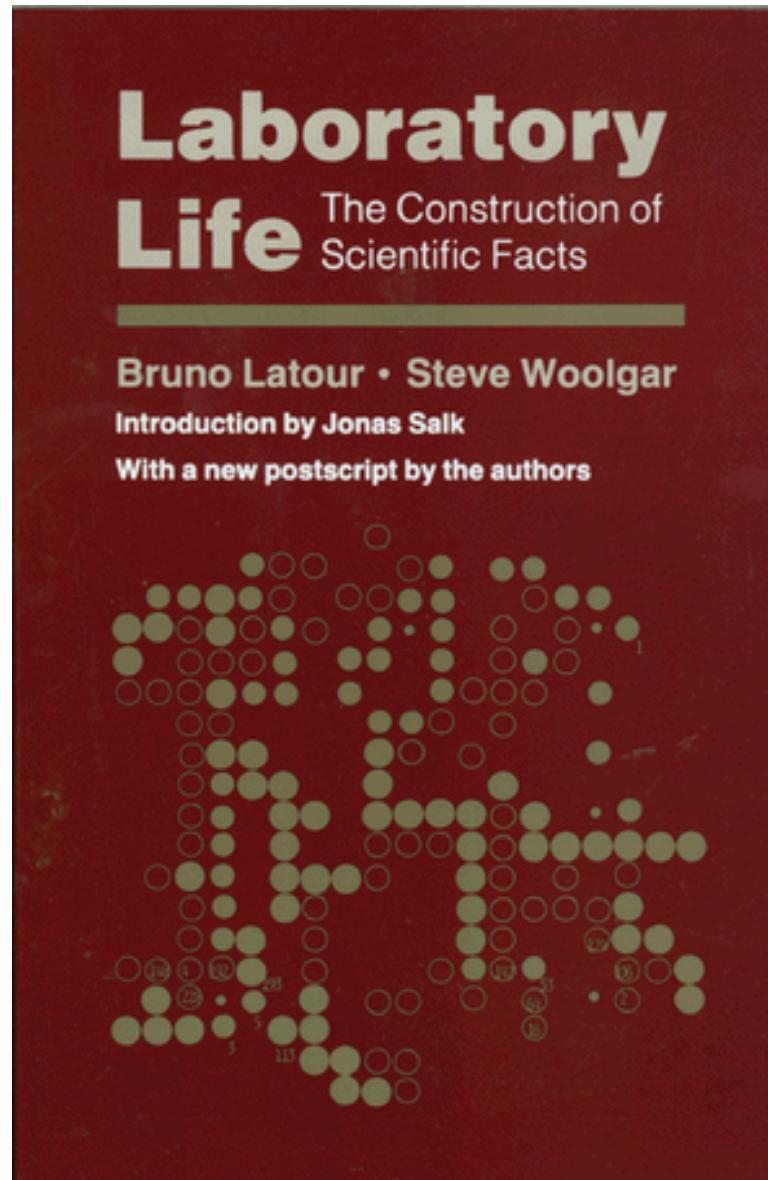
Vision

Skills

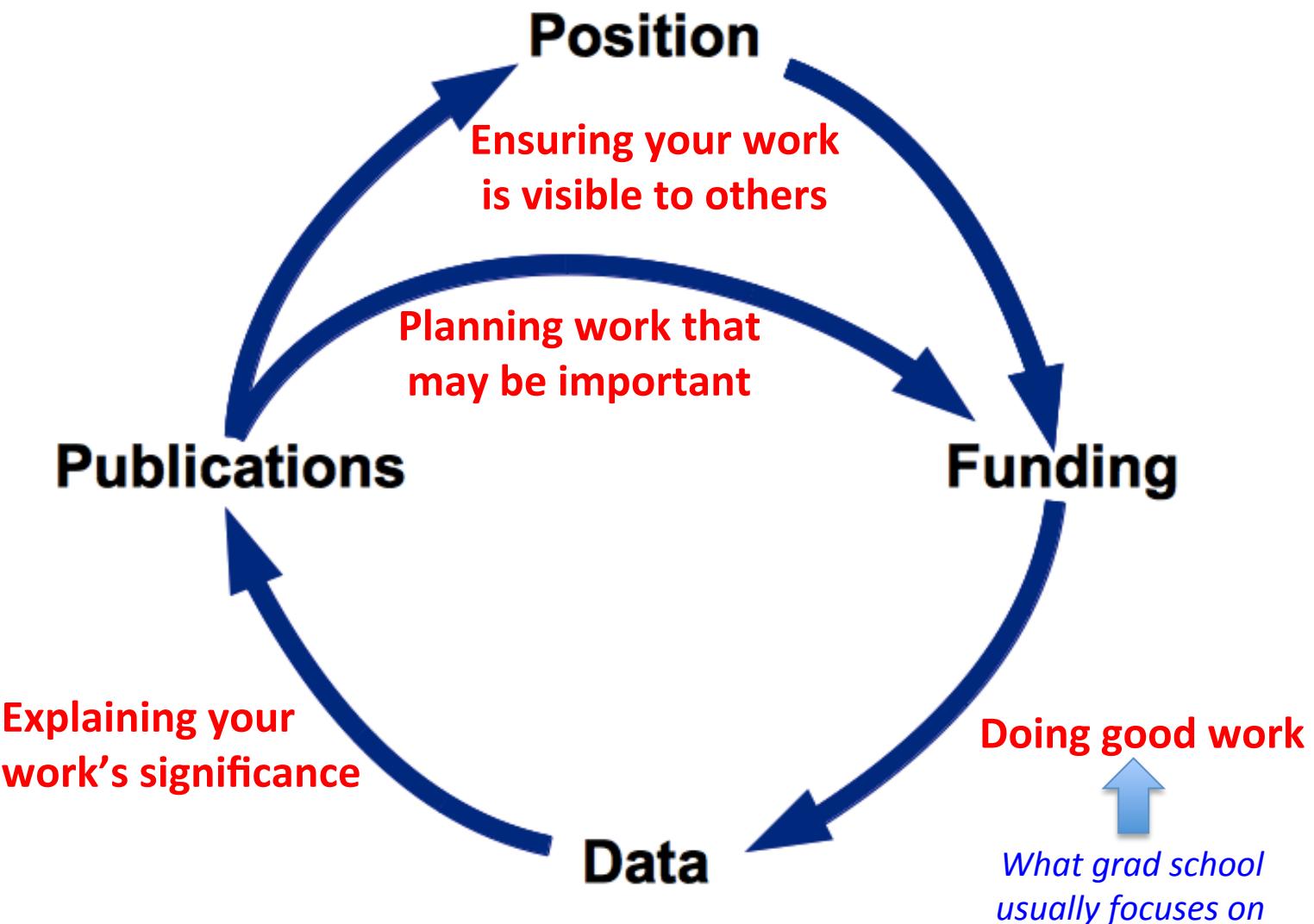
Application

*At different times, different aspects dominate*

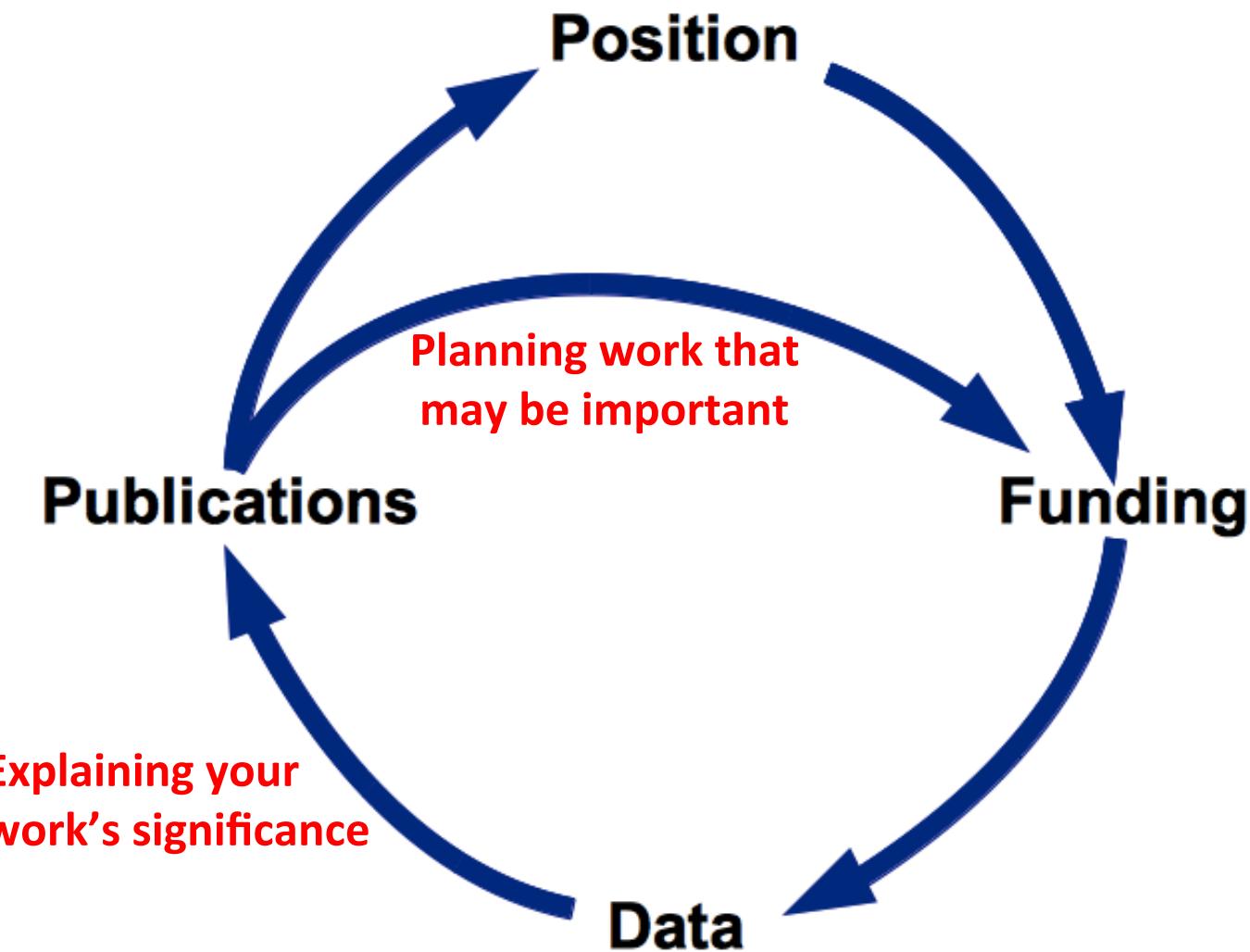
# Bruno Latour: Anthropology of Science



# Latour's Cycle of Credit



# Latour's Cycle of Credit



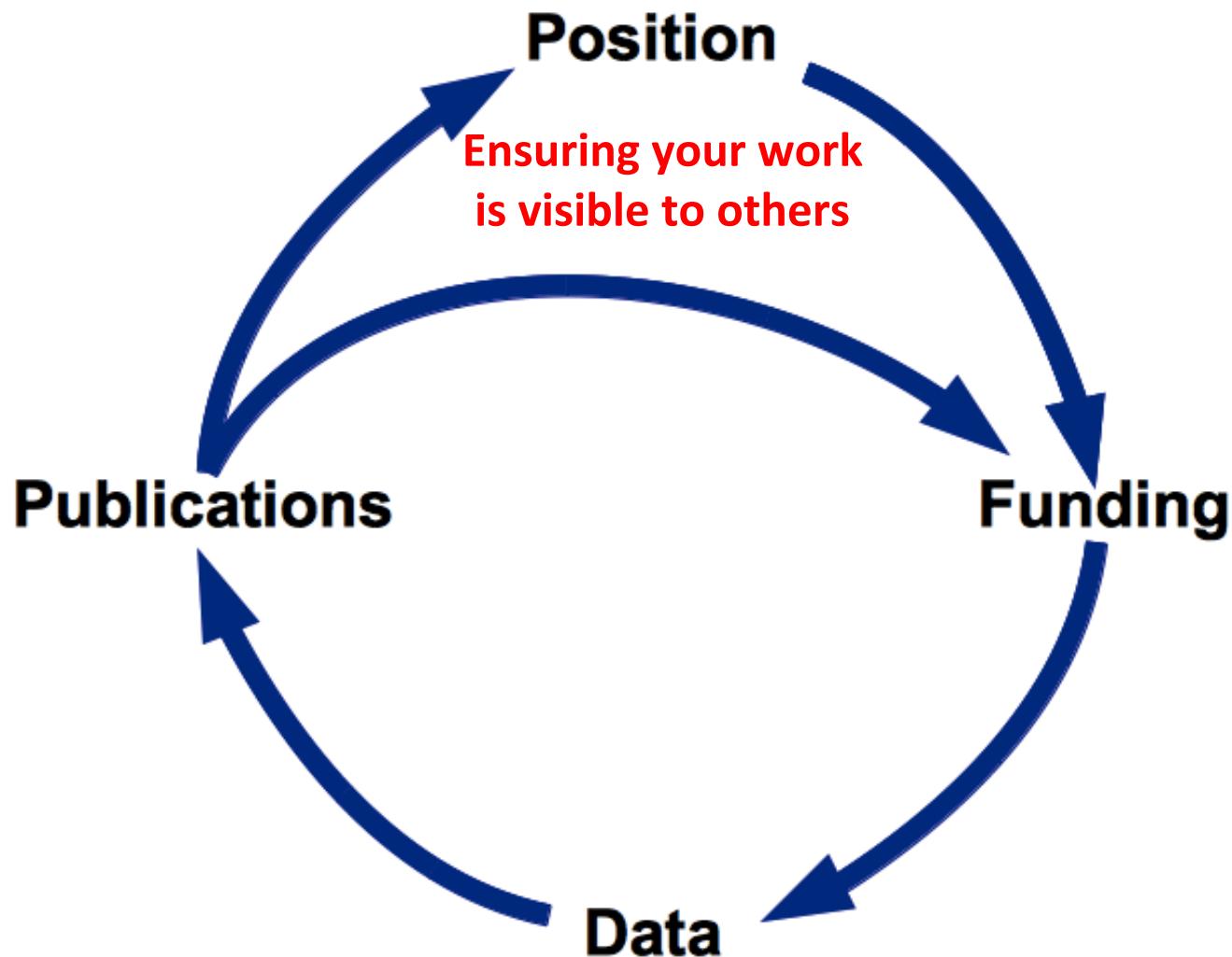
# Heilmeyer's Catechism

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- 1. What is the problem, why is it hard?
- 2. How is it solved today?
- 3. What is the new technical idea;  
why can we succeed now?
- 4. What is the impact if successful?
- 5. How will the program be organized?
- 6. How will intermediate results be generated?
- 7. How will you measure progress?
- 8. What will it cost?

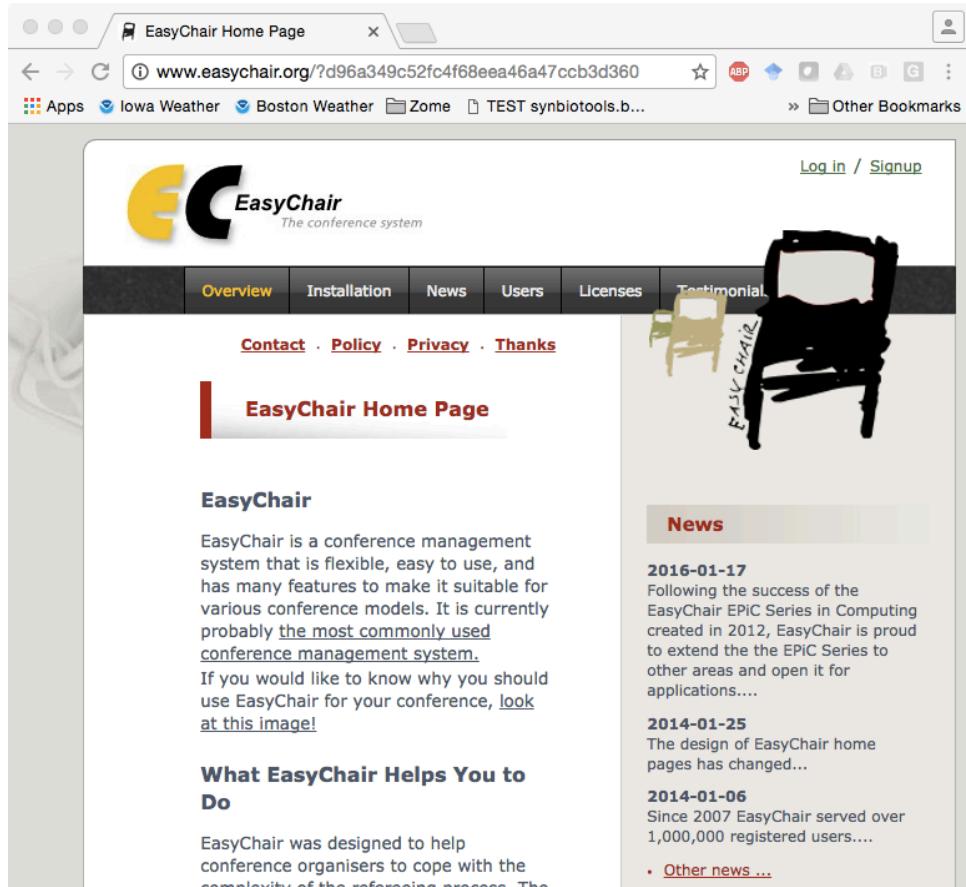


# Latour's Cycle of Credit



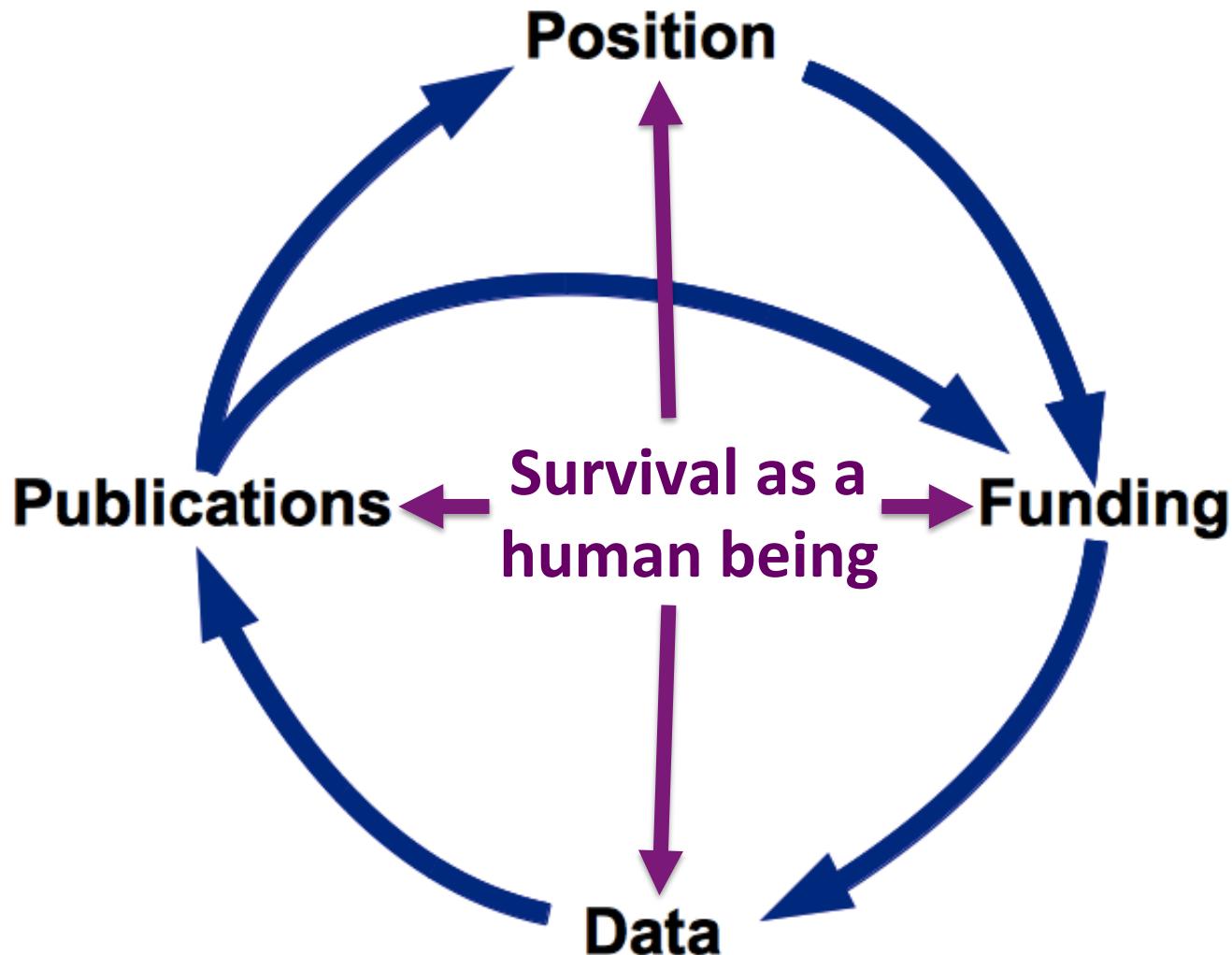
# Being visible in the community

- Organize events
- Review papers
- Give talks
- Help teach
- Serve on panels
- Write a blog
- Maintain your webpage



*I budget 4 hours / week for service & visibility*

# Latour's Cycle of Credit



# Imposter Syndrome

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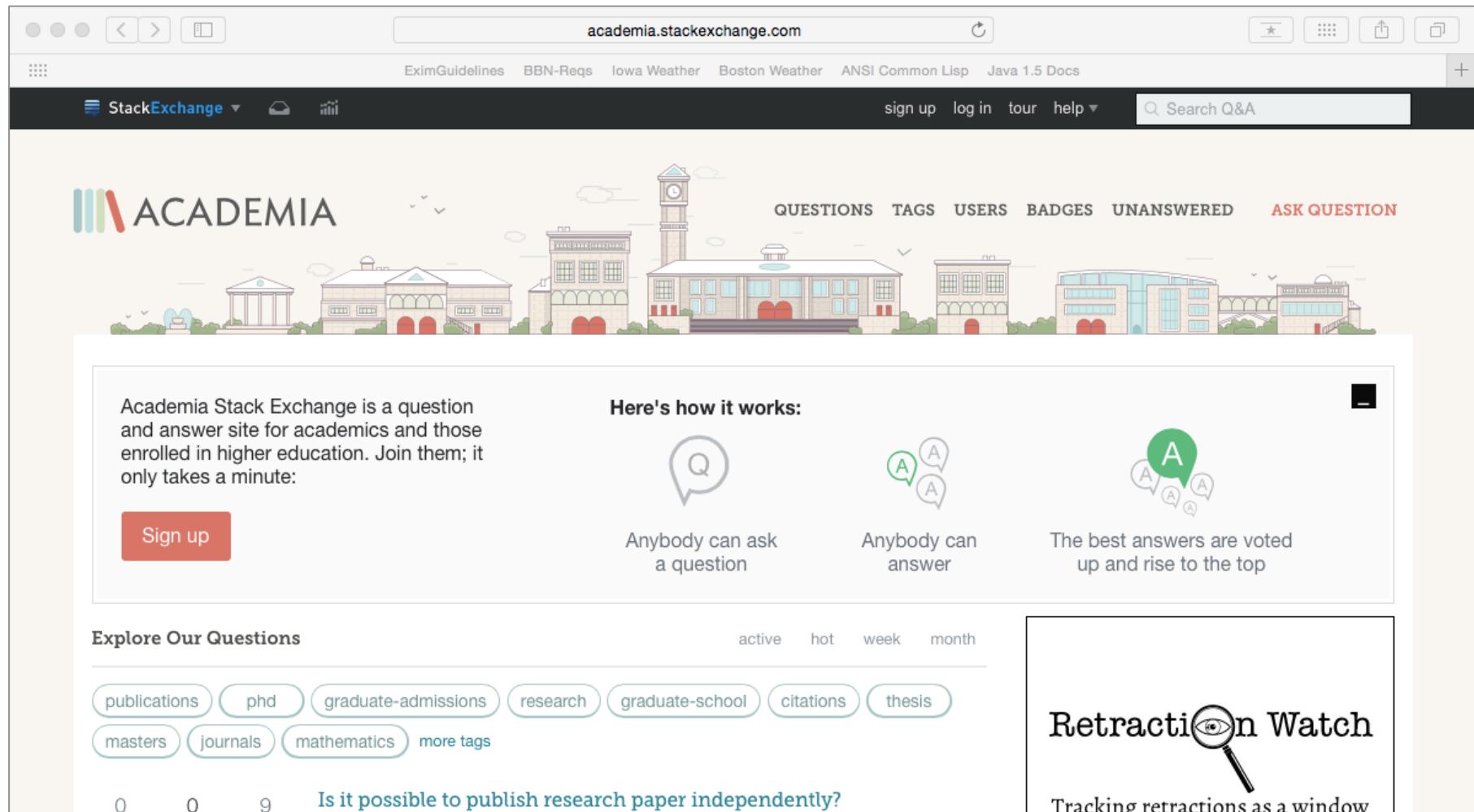
***Before nearly every conference I go to, before nearly every talk I give, I have a horrible moment of doubt, wondering why I am here.***

Remember:

- Everybody shows the face they want the world to see.
- Selection bias greatly distorts your view of the world.
- You and your work's value is not relative.
- Become comfortable working with areas of ignorance.

**Even just knowing about it can help a lot.**

# Find support for yourself



The screenshot shows the homepage of Academia Stack Exchange. At the top, there's a navigation bar with links to EximGuidelines, BBN-Req, Iowa Weather, Boston Weather, ANSI Common Lisp, Java 1.5 Docs, sign up, log in, tour, help, and a search bar. Below the navigation is a decorative header featuring a stylized illustration of various academic buildings under a sky with clouds. The word "ACADEMIA" is prominently displayed next to the illustration. To the right of the illustration are links for QUESTIONS, TAGS, USERS, BADGES, UNANSWERED, and a red "ASK QUESTION" button. The main content area has a light beige background. On the left, a box contains text about the site and a "Sign up" button. In the center, there are three icons: a speech bubble with a 'Q' for asking, a cluster of bubbles with 'A's for answering, and a green circle with an 'A' for voted answers. To the right of these icons is explanatory text. Below this section is a "Explore Our Questions" section with a list of tags: publications, phd, graduate-admissions, research, graduate-school, citations, thesis, masters, journals, mathematics, and more tags. At the bottom, there's a question card for "Is it possible to publish research paper independently?" with 0 upvotes, 0 downvotes, and 9 comments. To the right of the question is a sidebar titled "Retraction Watch" with the subtitle "Tracking retractions as a window".

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Here's how it works:

Anybody can ask a question

Anybody can answer

The best answers are voted up and rise to the top

Explore Our Questions

active hot week month

publications phd graduate-admissions research graduate-school citations thesis

masters journals mathematics more tags

0 0 9 Is it possible to publish research paper independently?

Retraction Watch

Tracking retractions as a window

*One of my favorite resources*

# Keep an eye on your life

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- It's never a good time for life.
- Do it anyway.
- Compromise, triage.
- Drop different balls.
- Keep track of your time:
  - Make time for focused work.
  - Do scut work in broken time.
  - Walk away from burnout.

