

# ReScience

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NICOLAS P. ROUGIER  
GITHUB.RESCIENCE.IO

APRIL 18<sup>TH</sup> 2018

Reproducible science is good.  
Replicated science is better.

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# How the Case for Austerity Has Crumbled

*In April 2013, Herndon, Ash & Pollin showed that the statistical analyses performed on the data in the original Reinhart-Rogoff Excel spreadsheet (which were used to support the conclusions of the paper) were flawed.*

Economist Paul Krugman (Swedish National Bank's Prize) later explained : *“What the Reinhart-Rogoff affair shows is the extent to which austerity has been sold on false pretenses. For three years, the turn to austerity has been presented not as a choice but as a necessity.”*

Article accessed online on March 28, 2017  
No corrections, no warning, wrong results still online  
Cited by more than 2,000 papers

## Growth in a Time of Debt

Carmen M. Reinhart, Kenneth S. Rogoff

**NBER Working Paper No. 15639**

**Issued in January 2010**

**NBER Program(s): IFM ME**

We study economic growth and inflation at different levels of government and external debt. Our analysis is based on new data on forty-four countries spanning about two hundred years. The dataset incorporates over 3,700 annual observations covering a wide range of political systems, institutions, exchange rate arrangements, and historic circumstances. Our main findings are: First, the relationship between government debt and real GDP growth is weak for debt/GDP ratios below a threshold of 90 percent of GDP. Above 90 percent, median growth rates fall by one percent, and average growth falls considerably more. We find that the threshold for public debt is similar in advanced and emerging economies. Second, emerging markets face lower thresholds for external debt (public and private)--which is usually denominated in a foreign currency. When external debt reaches 60 percent of GDP, annual growth declines by about two percent; for higher levels, growth rates are roughly cut in half. Third, there is no apparent contemporaneous link between inflation and public debt levels for the advanced countries as a group (some countries, such as the United States, have experienced higher inflation when debt/GDP is high.) The story is entirely different for emerging markets, where inflation rises sharply as debt increases.



**A non-technical summary of this paper is available in the [April 2010 NBER digest](#). You can sign up to receive the [NBER Digest](#) by email.**

This paper was revised on December 5, 2011

[Acknowledgments](#)

Machine-readable bibliographic record - [MARC](#), [RIS](#), [BibTeX](#)

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**Users who downloaded this paper also downloaded these:**

- |                            |   |
|----------------------------|---|
| Reinhart and Rogoff        | w14656 <a href="#">The Aftermath of Financial Crises</a>  |
| Giavazzi and Pagano        | <a href="#">Can Severe Fiscal Contractions Be Expansionary? Tales of Two Small European Countries</a>           |
| Ardagna, Caselli, and Lane | w10788 <a href="#">Fiscal Discipline and the Cost of Public Debt Service: Some Estimates for OECD Countries</a> |
| Caballero                  | w15636 <a href="#">The "Other" Imbalance and the Financial Crisis</a>   |
| Schularick and Taylor      | w15512 <a href="#">Credit Booms Gone Bust: Monetary Policy, Leverage Cycles and Financial Crises, 1870-2008</a> |

A SCIENTIST'S NIGHTMARE

## Software Problem Leads to Five Retractions

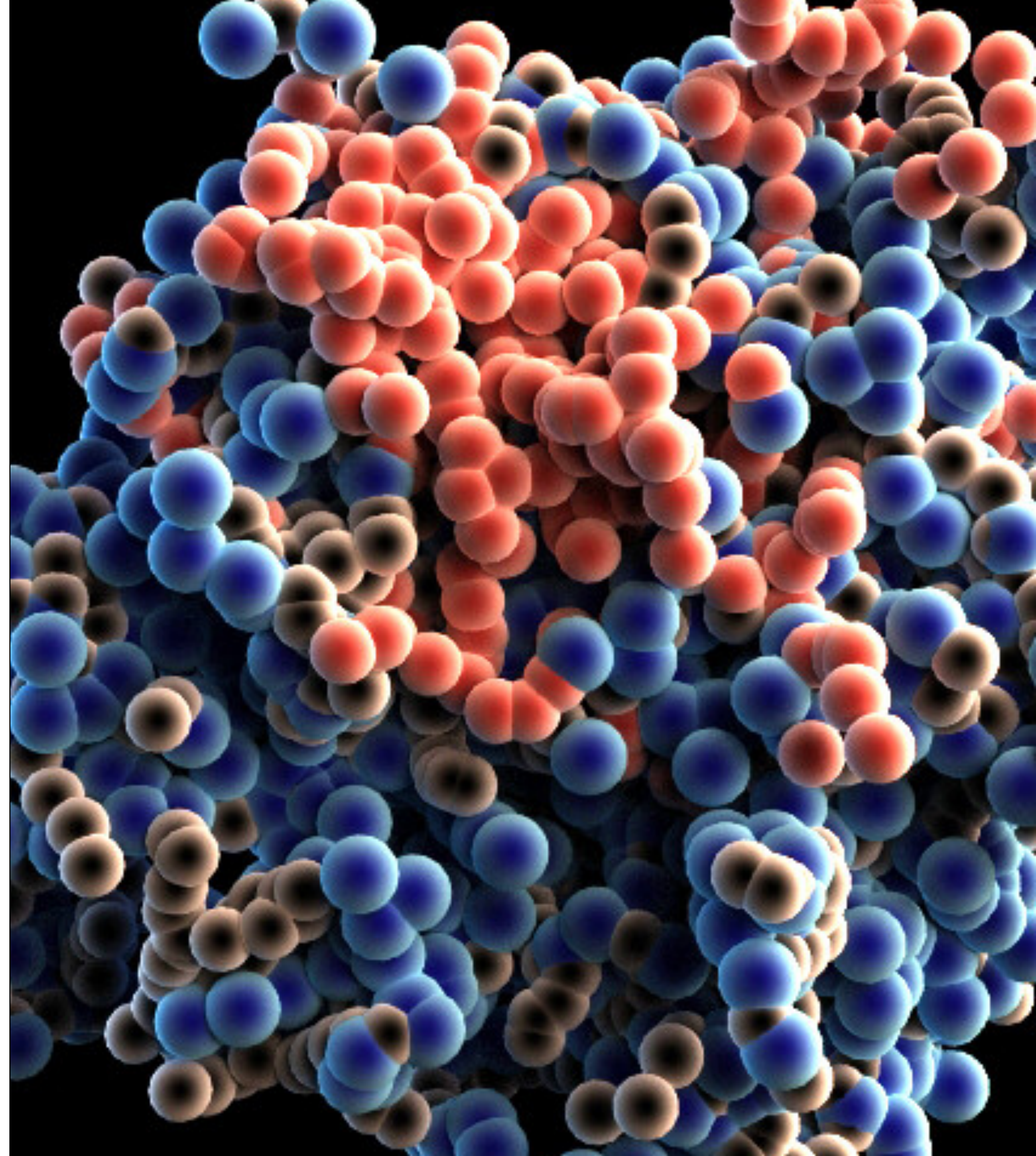
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*In September (2006), Swiss researchers published a paper in Nature that cast serious doubt on a protein structure Chang's group had described in a 2001 Science paper.*

*When he investigated, Chang was horrified to discover that a homemade data-analysis program had flipped two columns of data, inverting the electron-density map from which his team had derived the final protein structure.*

*"I've been devastated", Chang says. "I hope people will understand that it was a mistake, and I'm very sorry for it."*

A Scientist's Nightmare: Software Problem Leads to Five Retractions  
Greg Miller. Science, 2006

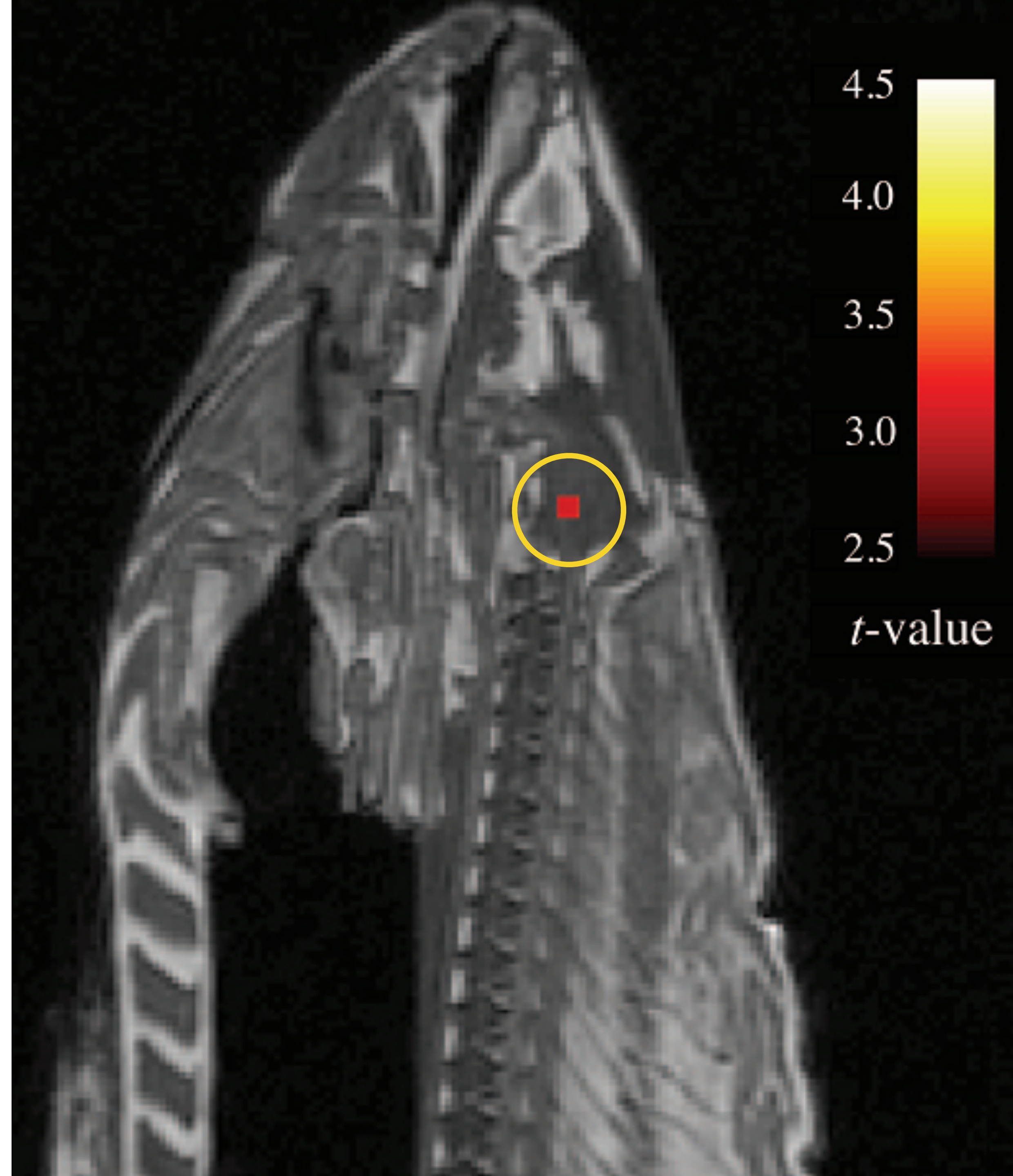


## The dead salmon study

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*"When they got around to analyze the voxel data, the voxels representing the area where the salmon's tiny brain sat showed evidence of activity. In the fMRI scan, it looked like the dead salmon was actually thinking about the pictures it had been shown. The result is completely nuts — but that's actually exactly the point.*

Bennett et al. "Neural Correlates of Interspecies Perspective Taking in the Post-Mortem Atlantic Salmon: An Argument For Proper Multiple Comparisons Correction" *Journal of Serendipitous and Unexpected Results*, 2010



# Science - Broken Science

Paywalled, proprietary tools & software, non shared data, non-reproducible, anonymous peer-review, **publish or perish (alone)!**

Nature 171 (1953)

Molecular Structure of Nucleic Acids: A Structure for Deoxyribose Nucleic Acid  
J.D. WATSON & F. H. C. CRICK.

**PAYWALLED (32\$)**

I have heard from graduate students opting out of academia, assistant professors afraid to come up for tenure, mid-career people wondering how to protect their labs, and senior faculty retiring early, all because of **methodological terrorism**.

APS Observer (2016)

**METHODOLOGICAL  
TERRORISM**

A second concern held by some is that a new class of research person will emerge — people who had nothing to do with the design and execution of the study but use another group's data for their own ends, possibly stealing from the research productivity planned by the data gatherers, or even **use the data to try to disprove** what the original investigators had posited. There is concern among some front-line researchers that the system will be taken over by what some researchers have characterized as **research parasites**

The New England Journal of Medicine (2016)

**RESEARCH  
PARASITES**



# Open Science - Science

Open Access, Open Source, Open Data, Open Methodology,  
Open Education, Open Peer-review, Much more fun & efficient!

Selected for a Viewpoint in *Physics*  
PHYSICAL REVIEW LETTERS week ending  
PRL 116, 061102 (2016) 12 FEBRUARY 2016

**Observation of Gravitational Waves from a Binary Black Hole Merger**  
B. P. Abbott *et al.*  
(LIGO Scientific Collaboration and Virgo Collaboration)  
(Received 21 January 2016; published 11 February 2016)

On September 14, 2015 at 09:50:45 UTC the two detectors of the Laser Interferometer Gravitational-Wave Observatory simultaneously observed a transient gravitational-wave signal. The signal sweeps upwards in frequency from 35 to 250 Hz with a peak gravitational-wave strain of  $1.0 \times 10^{-21}$ . It matches the waveform predicted by general relativity for the inspiral and merger of a pair of black holes and the ringdown of the resulting single black hole. The signal was observed with a matched-filter signal-to-noise ratio of 24 and a false alarm rate estimated to be less than 1 event per 203 000 years, equivalent to a significance greater than  $5.1\sigma$ . The source lies at a luminosity distance of  $410^{+160}_{-180}$  Mpc corresponding to a redshift  $z = 0.09^{+0.03}_{-0.04}$ . In the source frame, the initial black hole masses are  $36^{+5}_{-4} M_{\odot}$  and  $29^{+4}_{-4} M_{\odot}$ , and the final black hole mass is  $62^{+8}_{-7} M_{\odot}$ , with  $3.0^{+0.5}_{-0.5} M_{\odot} c^2$  radiated in gravitational waves. All uncertainties define 90% credible intervals. These observations demonstrate the existence of binary stellar-mass black hole systems. This is the first direct detection of gravitational waves and the first observation of a binary black hole merger.

DOI: 10.1103/PhysRevLett.116.061102

**I. INTRODUCTION**

In 1916, the year after the final formulation of the field equations of general relativity, Albert Einstein predicted the existence of gravitational waves. He found that the linearized weak-field equations had wave solutions: transverse waves of spatial strain that travel at the speed of light, generated by time variations of the mass quadrupole moment of the source [1,2]. Einstein understood that gravitational-wave amplitudes would be remarkably small; moreover, until the Chapel Hill conference in 1957 there was significant debate about the physical reality of gravitational waves [3].

Also in 1916, Schwarzschild published a solution for the field equations [4] that was later understood to describe a black hole [5,6], and in 1963 Kerr generalized the solution to rotating black holes [7]. Starting in the 1970s theoretical work led to the understanding of black hole quasinormal modes [8–10], and in the 1990s higher-order post-Newtonian calculations [11] preceded extensive analytical studies of relativistic two-body dynamics [12,13]. These advances, together with numerical relativity breakthroughs in the past decade [14–16], have enabled modeling of binary black hole mergers and accurate predictions of their gravitational waveforms. While numerous black hole candidates have now been identified through electromagnetic observations [17–19], black hole mergers have not previously been observed.

A century after the fundamental predictions of Einstein and Schwarzschild, we report the first direct detection of gravitational waves and the first direct observation of a binary black hole system merging to form a single black hole. Our observations provide unique access to the

The discovery of the binary pulsar system PSR B1913+16 by Hulse and Taylor [20] and subsequent observations of its energy loss by Taylor and Weisberg [21] demonstrated the existence of gravitational waves. This discovery, along with emerging astrophysical understanding [22], led to the recognition that direct observations of the amplitude and phase of gravitational waves would enable studies of additional relativistic systems and provide new tests of general relativity, especially in the dynamic strong-field regime.

Experiments to detect gravitational waves began with Weber and his resonant mass detectors in the 1960s [23], followed by an international network of cryogenic resonant detectors [24]. Interferometric detectors were first suggested in the early 1960s [25] and the 1970s [26]. A study of the noise and performance of such detectors [27], and further concepts to improve them [28], led to proposals for long-baseline broadband laser interferometers with the potential for significantly increased sensitivity [29–32]. By the early 2000s, a set of initial detectors was completed, including TAMA 300 in Japan, GEO 600 in Germany, the Laser Interferometer Gravitational-Wave Observatory (LIGO) in the United States, and Virgo in Italy. Combinations of these detectors made joint observations from 2002 through 2011, setting upper limits on a variety of gravitational-wave sources while evolving into a global network. In 2015, Advanced LIGO became the first of a significantly more sensitive network of advanced detectors to begin observations [33–36].

Full author list given at the end of the article.

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0031-9007/16/116(6)/061102(16) 061102-1 Published by the American Physical Society

Original  
Article

## SIGNAL PROCESSING WITH GW150914 OPEN DATA

Welcome! This ipython notebook (or associated python script GW150914\_tutorial.py) will go through some typical signal processing tasks on strain time-series data associated with the LIGO GW150914 data release from the LIGO Open Science Center (LOSC):

- <https://losc.ligo.org/events/GW150914/>
- View the tutorial as a web page - [https://losc.ligo.org/events/GW150914/GW150914\\_tutorial.html](https://losc.ligo.org/events/GW150914/GW150914_tutorial.html)
- Download the tutorial as a python script - [https://losc.ligo.org/s/events/GW150914/GW150914\\_tutorial.py](https://losc.ligo.org/s/events/GW150914/GW150914_tutorial.py)
- Download the tutorial as a Jupyter Notebook - [https://losc.ligo.org/s/events/GW150914/GW150914\\_tutorial.ipynb](https://losc.ligo.org/s/events/GW150914/GW150914_tutorial.ipynb)

To begin, download the ipython notebook, `readligo.py`, and the data files listed below, into a directory / folder, then run it. Or you can run the python script `GW150914_tutorial.py`. You will need the python packages: `numpy`, `scipy`, `matplotlib`, `h5py`.

In Windows, or if you prefer, you can use a python development environment such as Anaconda (<https://www.continuum.io/whats-anaconda>) or Enthought Canopy (<https://www.enthought.com/products/canopy/>).

Questions, comments, suggestions, corrections, etc: email [losc@ligo.org](mailto:losc@ligo.org)

v20160208b

### Intro to signal processing

This tutorial assumes that you know python well enough.

If you know how to use "python notebook", use the `GW150914_tutorial.ipynb` file. Else, you can use the `GW150914_tutorial.py` script.

This tutorial assumes that you know a bit about signal processing of digital time series data (or want to learn!). This includes power spectral densities, spectrograms, digital filtering, whitening, audio manipulation. This is a vast and complex set of topics, but we will cover many of the basics in this tutorial.

If you are a beginner, here are some resources from the web:

- <http://101science.com/dsp.htm>
- <https://georgendallas.wordpress.com/2014/05/14/wavelets-4-dummies-signal-processing-fourier-transforms-and-heisenberg/>
- [https://en.wikipedia.org/wiki/Signal\\_processing](https://en.wikipedia.org/wiki/Signal_processing)
- [https://en.wikipedia.org/wiki/Spectral\\_density](https://en.wikipedia.org/wiki/Spectral_density)
- <https://en.wikipedia.org/wiki/Spectrogram>
- <http://greenteapress.com/thinkdsp/>
- [https://en.wikipedia.org/wiki/Digital\\_filter](https://en.wikipedia.org/wiki/Digital_filter)

And, well, lots more - google it!

### Download the data

- Download the data files from LOSC:
- We will use the `hdf5` files, both `H1` and `L1`, with durations of 32 and 4096 seconds around GW150914, sampled at 16384 and 4096 Hz:
  - [https://losc.ligo.org/s/events/GW150914/H-H1\\_LOSC\\_4\\_V1-1126257414-4096.hdf5](https://losc.ligo.org/s/events/GW150914/H-H1_LOSC_4_V1-1126257414-4096.hdf5)
  - [https://losc.ligo.org/s/events/GW150914/L-L1\\_LOSC\\_4\\_V1-1126257414-4096.hdf5](https://losc.ligo.org/s/events/GW150914/L-L1_LOSC_4_V1-1126257414-4096.hdf5)
  - [https://losc.ligo.org/s/events/GW150914/H-H1\\_LOSC\\_16\\_V1-1126259446-32.hdf5](https://losc.ligo.org/s/events/GW150914/H-H1_LOSC_16_V1-1126259446-32.hdf5)
  - [https://losc.ligo.org/s/events/GW150914/L-L1\\_LOSC\\_16\\_V1-1126259446-32.hdf5](https://losc.ligo.org/s/events/GW150914/L-L1_LOSC_16_V1-1126259446-32.hdf5)
  - [https://losc.ligo.org/s/events/GW150914/GW150914\\_4\\_NR\\_waveform.txt](https://losc.ligo.org/s/events/GW150914/GW150914_4_NR_waveform.txt)
- Download the python functions to read the data: [https://losc.ligo.org/s/warmdms\\_code/readligo.py](https://losc.ligo.org/s/warmdms_code/readligo.py)
- From a unix/mac-osx command line, you can use `wget`, for example,
  - `wget https://losc.ligo.org/s/events/GW150914/H-H1_LOSC_4_V1-1126257414-4096.hdf5`
- Put these files in your current directory / folder. Don't mix any other LOSC data files in this directory, or `readligo.py` may get confused.

Here,

- "H-H1" means that the data come from the LIGO Hanford Observatory site and the LIGO "H1" detector;
- the "4" means the strain time-series data are (down-)sampled from 16384 Hz to 4096 Hz;
- the "V1" means version 1 of this data release;
- "1126257414-4096" means the data starts at GPS time 1126257414 (Mon Sep 14 09:16:37 GMT 2015), duration 4096 seconds;
  - NOTE: GPS time is number of seconds since Jan 6, 1980 GMT. See <http://www.oc.nps.edu/oc2302w/sos/timeys.html> or <https://losc.ligo.org/gps/>
- the filetype "hdf5" means the data are in hdf5 format: <https://www.hdfgroup.org/HDF5/>

Note that the 4096 second long files at 16384 Hz sampling rate are fairly big files (125 MB). You won't need them for this tutorial:

- [https://losc.ligo.org/s/events/GW150914/H-H1\\_LOSC\\_4\\_V1-1126257414-4096.hdf5](https://losc.ligo.org/s/events/GW150914/H-H1_LOSC_4_V1-1126257414-4096.hdf5)
- [https://losc.ligo.org/s/events/GW150914/L-L1\\_LOSC\\_4\\_V1-1126257414-4096.hdf5](https://losc.ligo.org/s/events/GW150914/L-L1_LOSC_4_V1-1126257414-4096.hdf5)
- [https://losc.ligo.org/s/events/GW150914/GW150914\\_4\\_NR\\_waveform.txt](https://losc.ligo.org/s/events/GW150914/GW150914_4_NR_waveform.txt)



Companion  
Notebook

## A WELL KNOWN STORY

Once upon a time, there was a post-doc...

*Interaction between cognitive and motor cortico-basal ganglia loops during decision making: a computational study.* M. Guthrie, A. Leblois, A. Garenne, and T. Boraud, Journal of Neurophysiology, 109, 2013

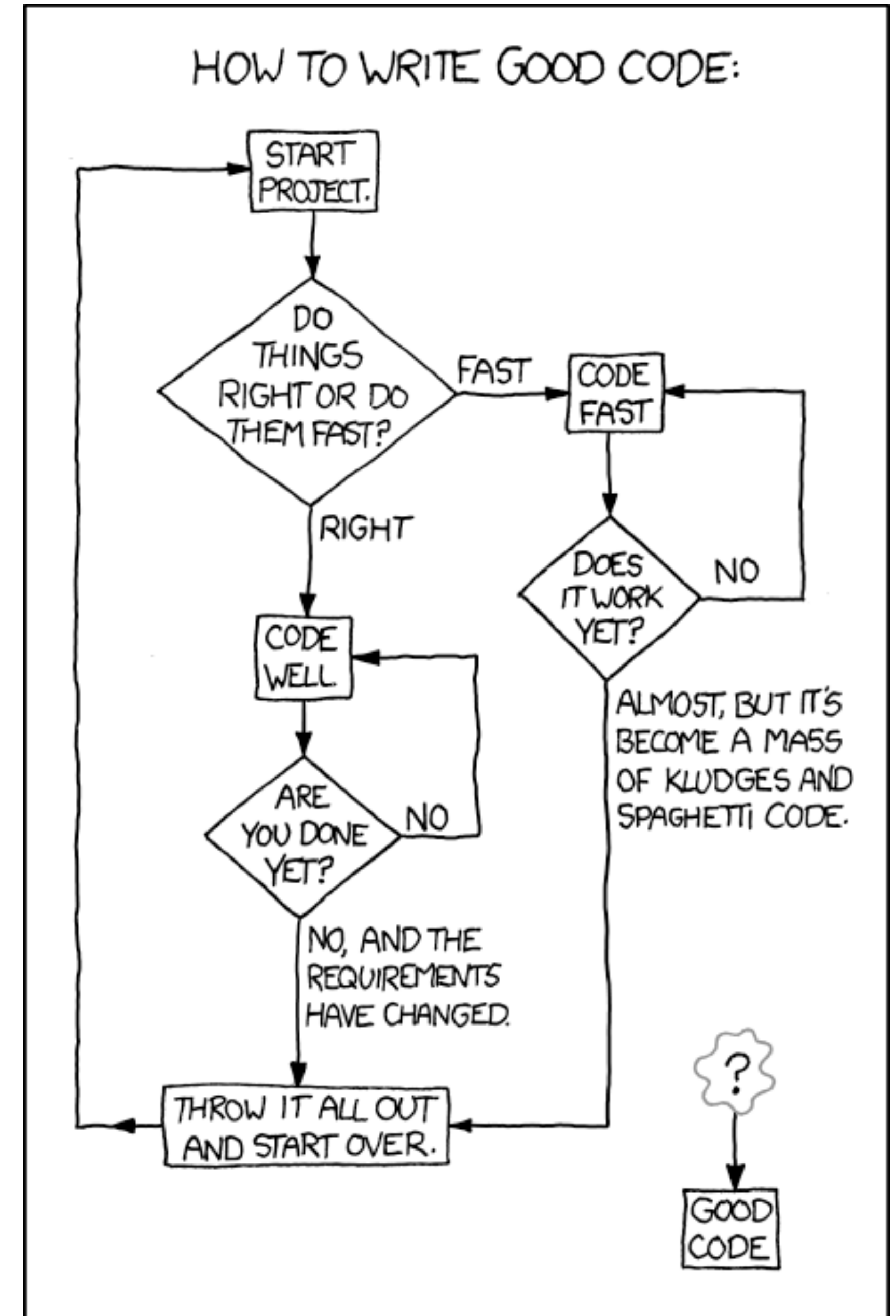
Nice paper, good results, but...

- No public repository, no version control
- Sources were mixing actual computation and GUI code
- Model was split into a hundred files, main file 6,000 lines long
- Several configuration files, no data saved
- Model description included ambiguous information

Model was hardly reproducible.

*You can download our code from the URL supplied. Good luck downloading the only postdoc who can get it to run, though...*

Ian Holmes





A LONG JOURNEY INTO

# Reproducible computational neuroscience

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Any model in Science is doomed to be proved wrong or incomplete and replaced by a more accurate one. In the meantime, for such replacement to happen, we have first to make sure that models are actually reproducible such that they can be tested, evaluated, criticized and ultimately modified, replaced or even rejected.

**This is where the shoe pinches.**

If we cannot reproduce a model in the first place, we're doomed to re-invent the wheel again and again, preventing us from building an incremental computational knowledge.

My field of research is quite different from computational neuroscience, but I recognize the problem described in this paper very well. The core issue has in my opinion been identified in the comment by Jan Moren: there is no obvious way to publish complex scientific models other than as part of simulation software.

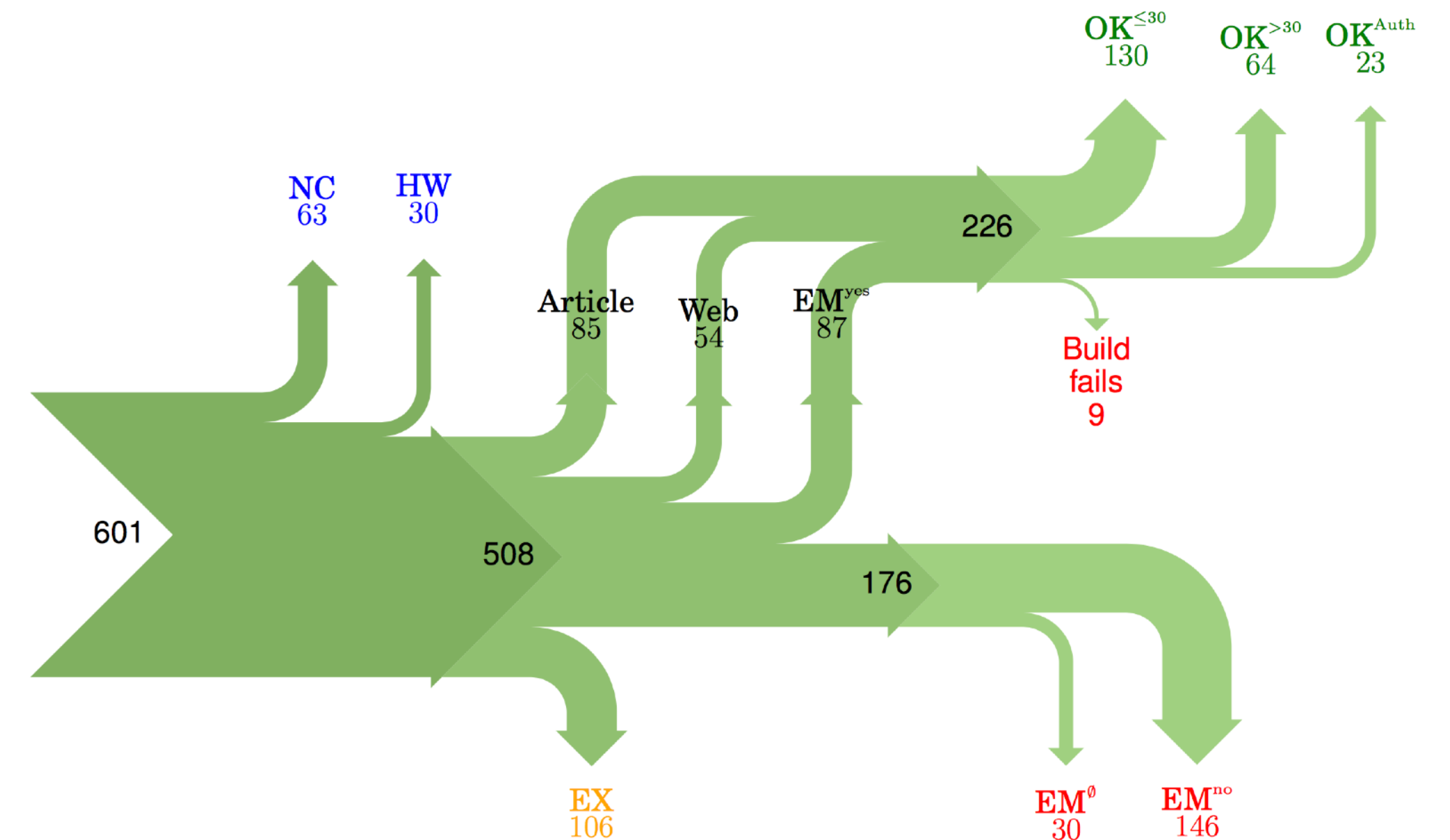
Konrad Hinsén, 2015



404 code not found

# Ma'am, the dog ate my program

*We describe a study into the extent to which Computer Systems researchers share their code and data and the extent to which such code builds. Starting with 601 papers from ACM conferences and journals, we examine 402 papers whose results were backed by code. For 32.3% of these papers we were able to obtain the code and build it within 30 minutes; for 48.3% of the papers we managed to build the code, but it may have required extra effort; for 54.0% of the papers either we managed to build the code or the authors stated the code would build with reasonable effort.*



# Ma'am, the dog ate my program

---

Reasons why code cannot be shared:

- Versioning Problems
- Code Will be Available Soon
- No Intention to Release
- Programmer Left
- Bad Backup Practices
- Commercial Code
- Proprietary Academic Code
- Industrial Lab Issues
- Unavailable Subsystems
- Multiple Reasons
- Intellectual Property
- Research vs. Sharing
- Security and Privacy
- Design Issues
- Too Busy to Help

⟨STUDENT⟩ was a graduate student in our program but he left a while back so I am responding instead. For the paper we used a prototype that included many moving pieces that only ⟨STUDENT⟩ knew how to operate and we did not have the time to integrate them in a ready-to-share implementation before he left. Still, I hope you can build on the ideas/technique of the paper. Regards,

Since this work has been done at ⟨COMPANY⟩ we don't open-source code unless there is a compelling business reason to do so. So unfortunately I don't think we'll be able to share it with you.

Thank you for your interest in our work. Unfortunately the current system is not mature enough at the moment, so it's not yet publicly available. We are actively working on a number of extensions and things are somewhat volatile. However, once things stabilize we plan to release it to outside users. At that point, we would be happy to send you a copy.

Thanks for your interest in the implementation of our paper. The good news is that I was able to find some code. I am just hoping that it is a stable working version of the code, and matches the implementation we finally used for the paper. Unfortunately, I have lost some data when my laptop was stolen last year. The bad news is that the code is not commented and/or clean. So, I cannot really guarantee that you will enjoy playing with it.

The code used to implement the ⟨CONFERENCE⟩ paper is complete, but hardly usable by anyone other than the authors. This is due in large part due to our decision to use Template Haskell for the input language. The error messages which are produced by the compiler are useless to anyone not fluent in both Haskell, BSV, and the compiler architecture.

LET'S PYTHONIZE IT

## A brand new implementation

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Remember? *Interaction between cognitive and motor cortico-basal ganglia loops during decision making: a computational study*. M. Guthrie, A. Leblois, A. Garenne, and T. Boraud, *Journal of Neurophysiology*, 109, 2013. → 100 files, 6,000 lines of Delphi

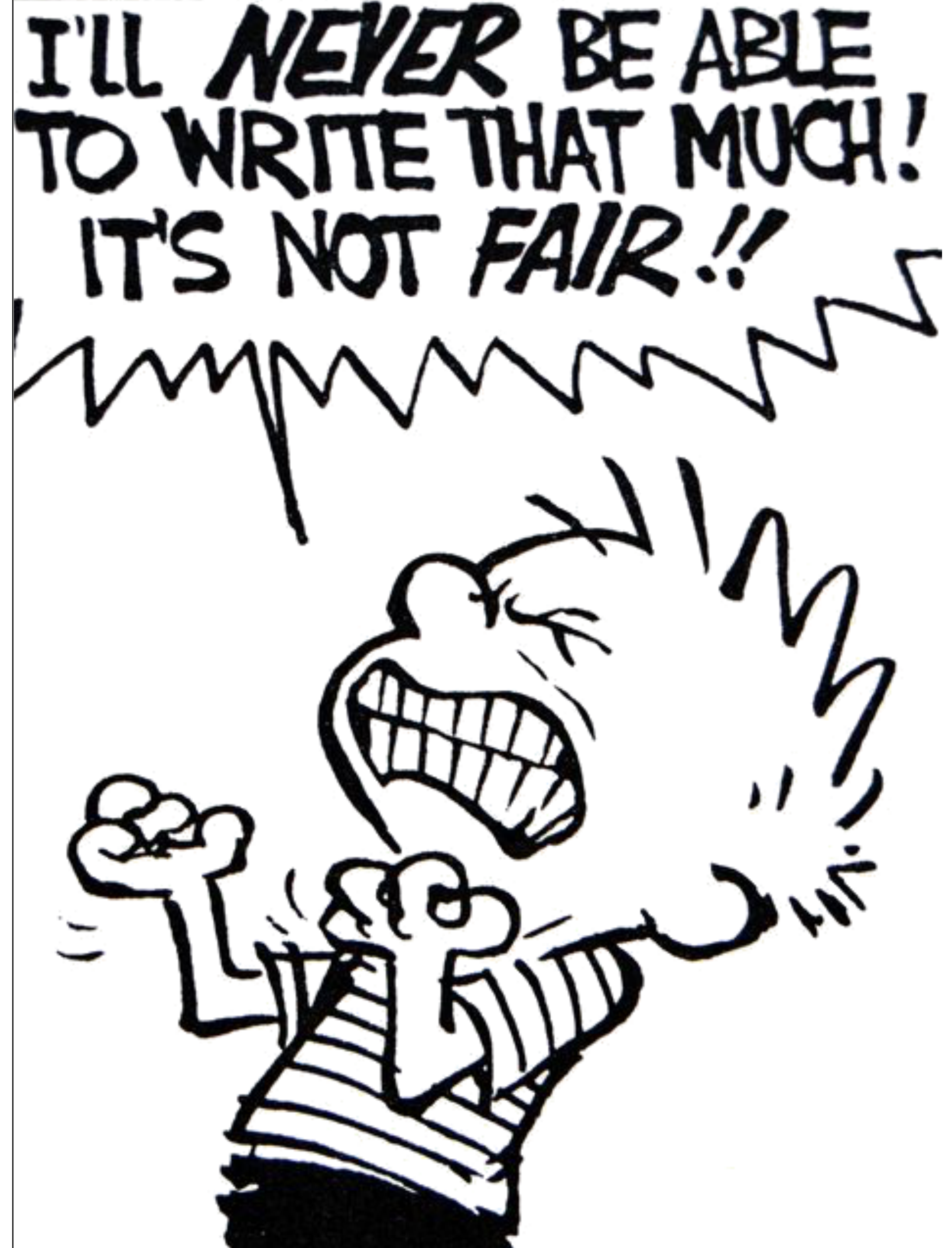
I asked my PhD student (M. Topalidou) to write a brand new implementation. Together, it took us three months of hard work to replicate the model using

- Python language and numerical libraries
- DANA library for intuitive description
- IPython notebook for interactive sessions

Source is now a single file of 200 readable notebook available on GitHub. Without this replication effort, original model would have been useless for our research.

Because of strong incentives for innovation and weak incentives for confirmation, direct replication is rarely practiced or published... Innovative findings produce rewards of publication, employment, and tenure; replicated findings produce a shrug.

Brian Nosek, The Reproducibility Project, 2012



WHAT DO WE DO

NEXT ?



WE ARE NOT INTERESTED IN SCIENCE

'cause we are \$cientific publishers\$

---

- Elsevier, can I publish my replication in your journal?
- Nope!
  
- Hi Springer, interested in replication?
- Failure or success?
- **Success!**
- Nope!
  
- Hello Mr Wiley, did you hear about reproducible Science?
- tut.... tut.... tut...
  
- Dear beloved Frontiers, can you review this?
- Ha ha ha.... No.
  
- Well, well, well...



## BEFORE WE BEGIN

# The R quintuplet (R<sup>5</sup>)

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### Rerunnable

Can you re-run your program ?

One day, one week, one month, one year (just kidding) apart ?

### Repeatable

Can you re-run your program and get same results ?

Did you save everything, including random seed ?

### Reproducible

Can someone re-run your program and get same results ?

Did you save the software stack ?

### Replicable

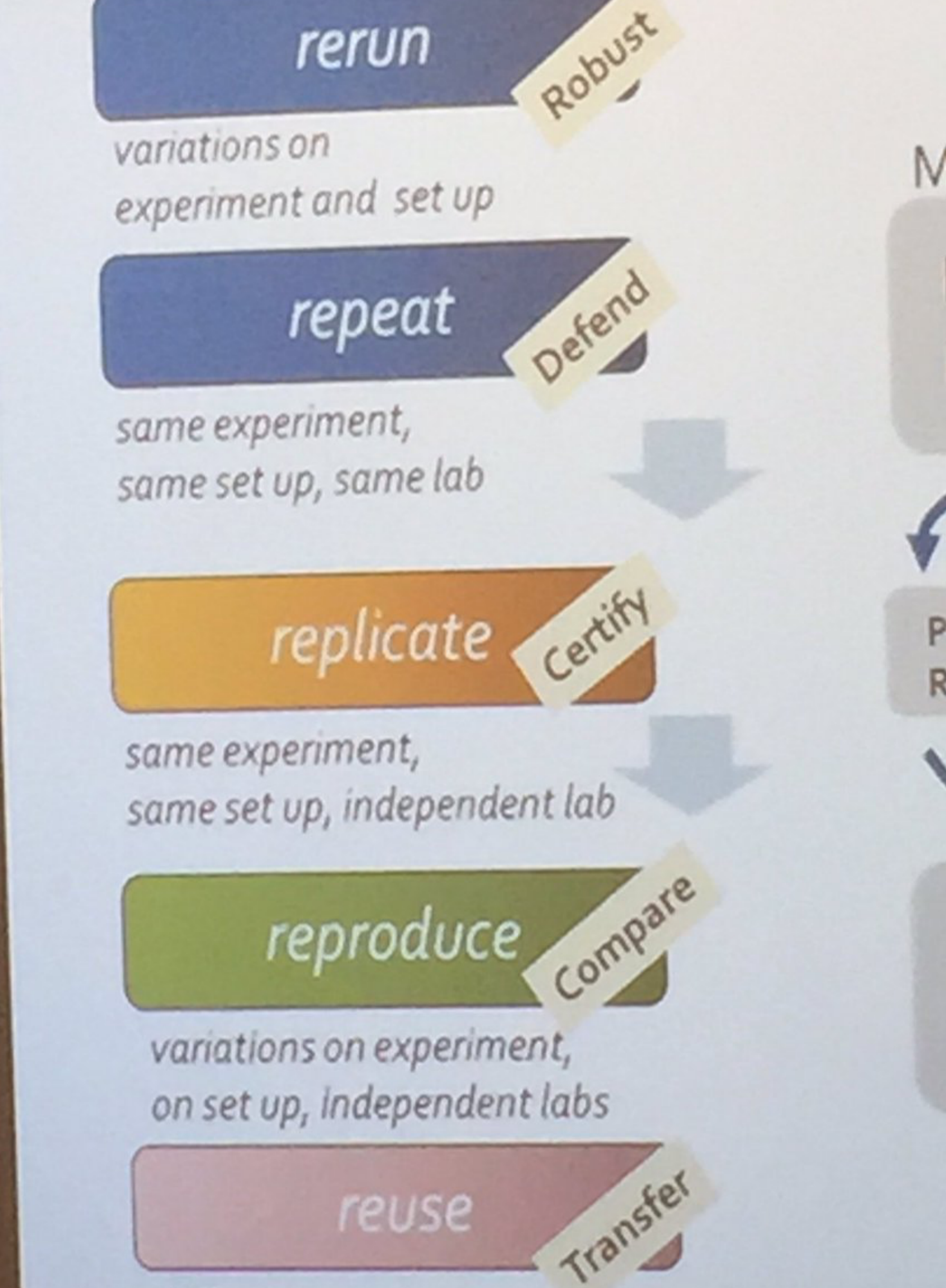
Can someone reimplement your model and get same results ?

Did you describe everything ?

### Reusable

Can someone reuse your program using different data ?

Is your software data-dependent ?



IT'S MORE COMMON THAN YOU THINK

## Replications in the wild

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### What is a replication?

Bob reads Alice's paper, takes note of all model properties and then implements the model himself using a method of his choice.

Bob confirms Alice's result by obtaining qualitatively the same results.

Alice's model has been replicated.

### Who wants to write replication?

During the course of a PhD, it is often the case that a student will try to replicate results from the literature, possibly interacting with the original authors.

Such replication generally lives inside the hard-drive of the computer's student while it would be actually useful for the whole scientific community.

### Who wants to review & publish such replication?

We do!





INTRODUCING

## The ReScience journal

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ReScience is an open peer-reviewed journal that target any computational research and encourage the explicit replication of already published research promoting new and open-source implementations.

ReScience lives on github where each new implementation is made available together with explanations (article).

Each published article is archived on Zenodo.

Zenodo is a research data repository created by OpenAIRE and CERN to provide a place for researchers to deposit datasets.

GitHub is a web-based Git repository hosting service that offers all of the distributed version control and source code management functionality of git as well as adding its own features.



# ReScience

Reproducible science is good. Replicated science is better.

CHOICES HAD TO BE MADE

## Why GitHub ?

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GitHub offers a web-based git repository hosting service with great specific features (issue, pull request, etc).

- Version control
- Public repositories
- Transparency and verifiability
- Easy exploration of new ideas

A kind of modern lab notebook for the computer scientist.

- Popular among developers (Google, Microsoft, etc.)
- Ergonomic & efficient
- Free (as in beer)

But

- Closed sources
- Ran by a private company
- Can close tomorrow



## SUBMISSION PROCESS

# Initial pull request

Replication of a result in any computational science is eligible for submission and publication in ReScience.

1. Fork the submission repository
2. Write your code, data and article
3. Submit a pull request
4. Wait for reviews
5. Chat with reviewers and answer questions
6. Fix bugs and address comments
7. Get published and get a DOI

Pull requests let you tell others about changes you've pushed to a repository on GitHub. Once a pull request is opened, you can discuss and review the potential changes with collaborators and add follow-up commits before the changes are merged into the repository.

## Review Request: Stollmeier #27

 Open Fjanks wants to merge 3 commits into ReScience:master from Fjanks:STOLLMEIER-2017

 Conversation 23  Commits 3  Files changed 21

+27,473 -19



Fjanks commented on Feb 22 • edited by rougier

First-time contributor



### AUTHOR

Dear @ReScience/editors,

I request a review for the following replication:

### Original article

**Title:** A simple rule for the evolution of cooperation on graphs and social networks

**Author(s):** H. Ohtsuki, C. Hauert, E. Lieberman and M.A. Nowak

**Journal (or Conference):** Nature

**Year:** 2006

**DOI:** 10.1038/nature04605

**PDF:** [http://projects.iq.harvard.edu/files/ped/files/nature06a\\_0.pdf](http://projects.iq.harvard.edu/files/ped/files/nature06a_0.pdf) (SI: <http://www.nature.com/nature/journal/v441/n7092/extref/nature04605-s1.pdf>)

### Replication

**Author(s):** F. Stollmeier (ORCID: 0000-0003-4858-0895)

**Repository:** <https://github.com/Fjanks/ReScience-submission/tree/STOLLMEIER-2017>

**PDF:** <https://github.com/Fjanks/ReScience-submission/blob/STOLLMEIER-2017/article/stollmeier-2017.pdf>

**Keywords:** Evolutionary Game Theory, Networks

**Language:** English

**Domain:**

### Results

- Article has been fully replicated
- Article has been partially replicated
- Article has not been replicated

### EDITOR

- Editor acknowledgement (@ctb) February 24, 2017
- Reviewer 1 (@AdamRTomkins) February 27, 2017
- Reviewer 2 (@anyaevostinar) February 28, 2017
- Review 1 decision [accept/reject]
- Review 2 decision [accept/reject]

### Reviewers

Suggestions

 rougier

### Assignees

 ctb

### Labels

O2 - Review

Physical Science

Python

### Projects

None yet

### Milestone

No milestone

### Notifications

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 Lock conversation

## SUBMISSION PROCESS

# Open peer-review

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Editor is publicly assigned by editor-in-chief.

Reviewers are publicly invited to review (they can decline the invitation of course)

The actual review takes place in the discussion area of the pull request. Anybody can enter the discussion unless this discussion is locked.

This means anybody can give advice and/or comment because this discussion is public.



The screenshot shows a GitHub discussion thread with four comments. The first comment is from user 'anyaevoستinar' (9 days ago), mentioning '@rougier' and providing system configuration details. The second comment is also from 'anyaevoستinar' (9 days ago), showing a compiler error message and stating they can import numpy in Python. The third comment is from 'Fjanks' (9 days ago), explaining the error and providing a Python setup script. The fourth comment is from 'anyaevoستinar' (5 days ago), reporting that the error persists when using python3.

**anyaevoستinar** commented 9 days ago Member +👤 ✎ ✕

**@rougier** Yes, though here is the full version info:  
Configured with: `--prefix=/Applications/Xcode.app/Contents/Developer/usr --with-gxx-include-dir=/usr/include/c++/4.2.1 Apple LLVM version 7.0.2 (clang-700.1.81) Target: x86_64-apple-darwin14.5.0 Thread model: posix`

**@Fjanks** That pyximport code works correctly with only 'unused function' warnings. I'll try without pyximport anyway.

**anyaevoستinar** commented 9 days ago Member +👤 ✎ ✕

When building algorithms with distutils I get:  
`algorithms.c:232:10: fatal error: 'numpy/arrayobject.h' file not found #include "numpy/arrayobject.h"`

I can import numpy into Python fine, so I'm not sure what the problem is.

**Fjanks** commented 9 days ago +👤 ✎ ✕

Ok, that's not what I expected, but this error message is much more informative than the one before. It doesn't find the numpy header files automatically. The good news is that numpy itself knows where they are, it has a function `numpy.get_include()`. Please try this setup.py:

```
from distutils.core import setup
from Cython.Build import cythonize
import numpy

setup(
    name = 'algorithms',
    ext_modules = cythonize("algorithms.pyx", include_path = [numpy.get_include()]),
)
```

**anyaevoستinar** commented 5 days ago Member +👤 ✎ ✕

That does not seem to fix the error, when I try with python3 I get this:

```
python3 setup.py build_ext --inplace running build_ext building 'algorithms' extension
creating build/temp.macosx-10.6-intel-3.4 gcc-4.2 -fno-strict-aliasing -fno-common -dynamic
-DNDEBUG -g -fwrapv -O3 -Wall -Wstrict-prototypes -arch i386 -arch x86_64 -g -
I/Library/Frameworks/Python.framework/Versions/3.4/include/python3.4m -c algorithms.c -o
build/temp.macosx-10.6-intel-3.4/algorithms.o algorithms.c:232:31: error:
numpy/arrayobject.h: No such file or directory algorithms.c:233:31: error:
numpy/ufuncobject.h: No such file or directory algorithms.c:544: error: expected '=', ',',
';', 'asm' or 'attribute' before 'pyx t 5numpy int8 t'
```

## Editors & reviewers

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Editors are contacted by editors-in-chief (K. Hinsén & N. Rougier) and invited to join the board of editors based on their GitHub expertise and their scientific domain.

Reviewers can freely apply to become reviewer. They only need to indicate their scientific domain, their preferred programming language and their ORCID number (no PhD required)

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# Markdown to Latex to PDF

Articles are written in markdown and transformed into a latex file using pandoc. The latex file is processed using XeLatex.

DOI is obtained from Zenodo after having uploaded an archive of the article, the code, the data and the notebook.

Title is the original title with a [Re] prefix (when replication succeeded) and [¬Re] when replication failed.

Original author(s) and editor are informed of the success or the failure of the replication.



[Re] Interaction between cognitive and motor cortico-basal ganglia loops during decision making: a computational study

Meropi Topalidou<sup>1, 2, 3</sup> and Nicolas P. Rougier<sup>1, 2, 3</sup>

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[Nicolas.Rougier@inria.fr](mailto:Nicolas.Rougier@inria.fr)

#### Editor

Tiziano Zito

#### Reviewers

Benoît Girard  
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#### Competing Interests:

The authors have declared that no competing interests exist.

 [Code repository](#)

#### A reference implementation of

→ *Interaction between cognitive and motor cortico-basal ganglia loops during decision making: a computational study*, M. Guthrie, A. Leblois, A. Garenne, and T. Boraud, *Journal of Neurophysiology*, 109, 2013.

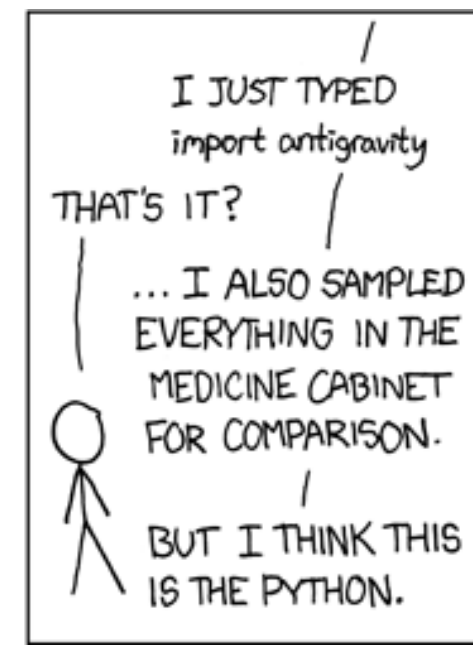
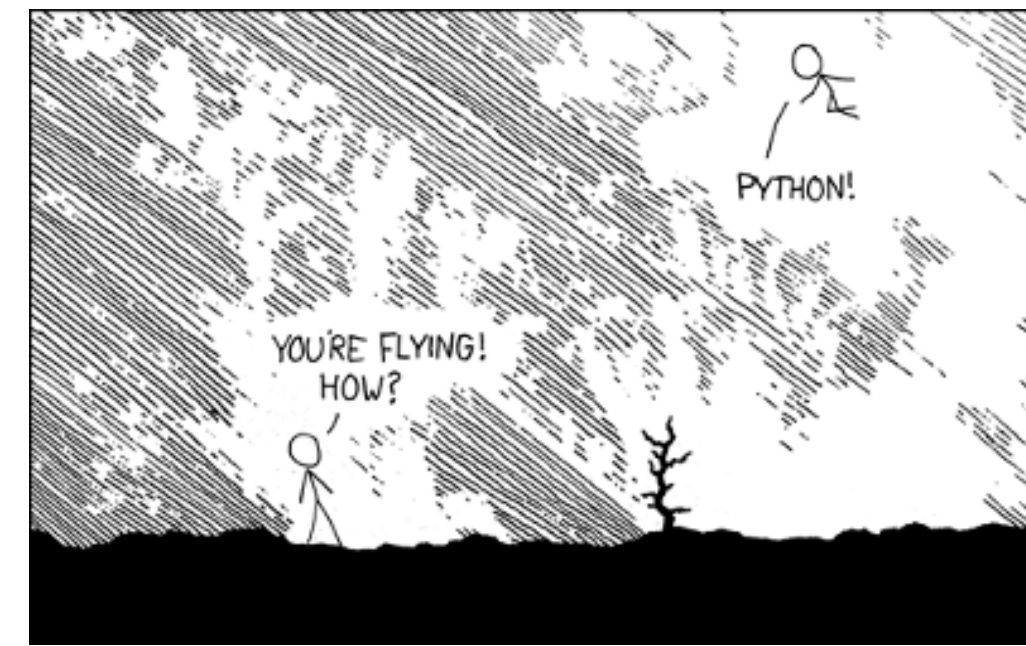
## Introduction

We propose a reference implementation of [1] that introduces an action selection mechanism in cortico-basal ganglia loops based on a competition between the positive feedback, direct pathway through the striatum and the negative feedback, hyperdirect pathway through the subthalamic nucleus. The original implementation was made in Delphi (Object Pascal) whose sources are available on request to any of the author of the original article. We have used these sources to disambiguate ambiguous and missing information in the original article. The reference implementation we propose has been coded in Python for ease of reading and Cython for performances because the main result includes a batch of 250 experiments over 120 trials that would be too slow for regular Python scripts.

## Methods

We used the description of the model in the original article as well as the sources of the model (requested from author) that are made of a hundred files and 6,000 lines of Delphi for the main source. We have been unable to compile this original implementation but we were able to run the provided Windows executable. We found some factual errors in the original article that have been corrected in this implementation. The initialization of weights are defined in two different parts of the paper. First on page 3030 (second column) “Weights were initialized to a Gaussian distribution with a mean of 0.5 and a SD of 0.005 at the start of each simulation...”, then on page 3031 in the caption of figure 4, “All synaptic weights were initialized to 0.5”. It happened that both definitions are right but do not address the same projections. Cortico-striatal synaptic weights use Gaussian distribution while all other weights are set to 0.5. Furthermore, the Boltzmann equation given in the original paper uses a  $\cdot$  instead of  $+$  between first term and second term.

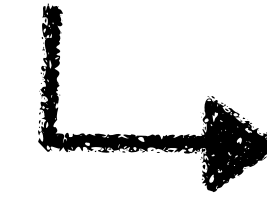
# The Lazarus effect



LEBLOIS ET AL. (2006)



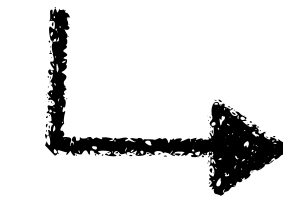
MISSING IN ACTION (FEW LINES OF C)



GUTHRIE ET AL. (2013)



DEAD (6000 LINES OF DELPHI)



TOPALIDOU ET AL. (2015) (200 LINES OF PYTHON)



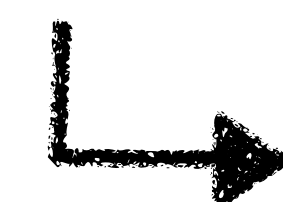
PIRON ET AL. (2016)



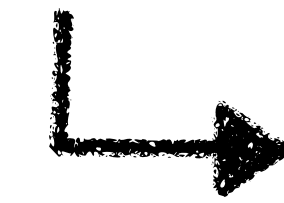
ESCOBAR ET AL., 2016  
NALLAPU ET AL., 2016  
CARREIRE ET AL., 2015



TOPALIDOU ET AL. (2017)



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# Frequently Asked Questions

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## What if I cannot replicate a result?

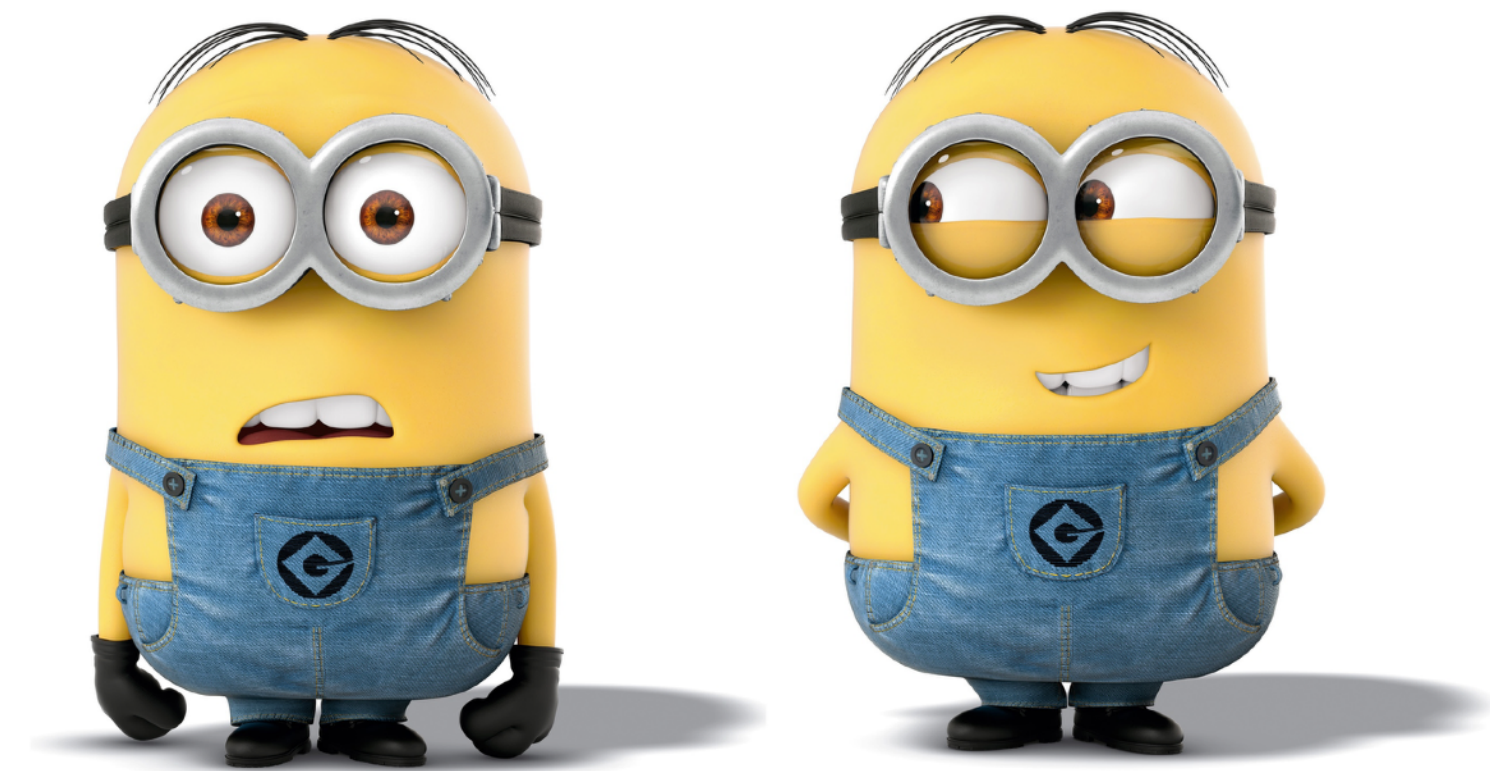
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If no errors are found, your work will be accepted and the original research will be declared non-replicable.

## What about replication of my own work?

No. Mistakes in the implementation of research questions and methods are often due to biases authors invariably have, consciously or not. One's biases will inevitably carry over to how one approaches a replication.

Perhaps even more importantly, we aim at the cross-fertilization of research and trying to replicate the work of one's peers might pave the way for a future collaboration, or may give rise to new ideas as a result of the replication effort.





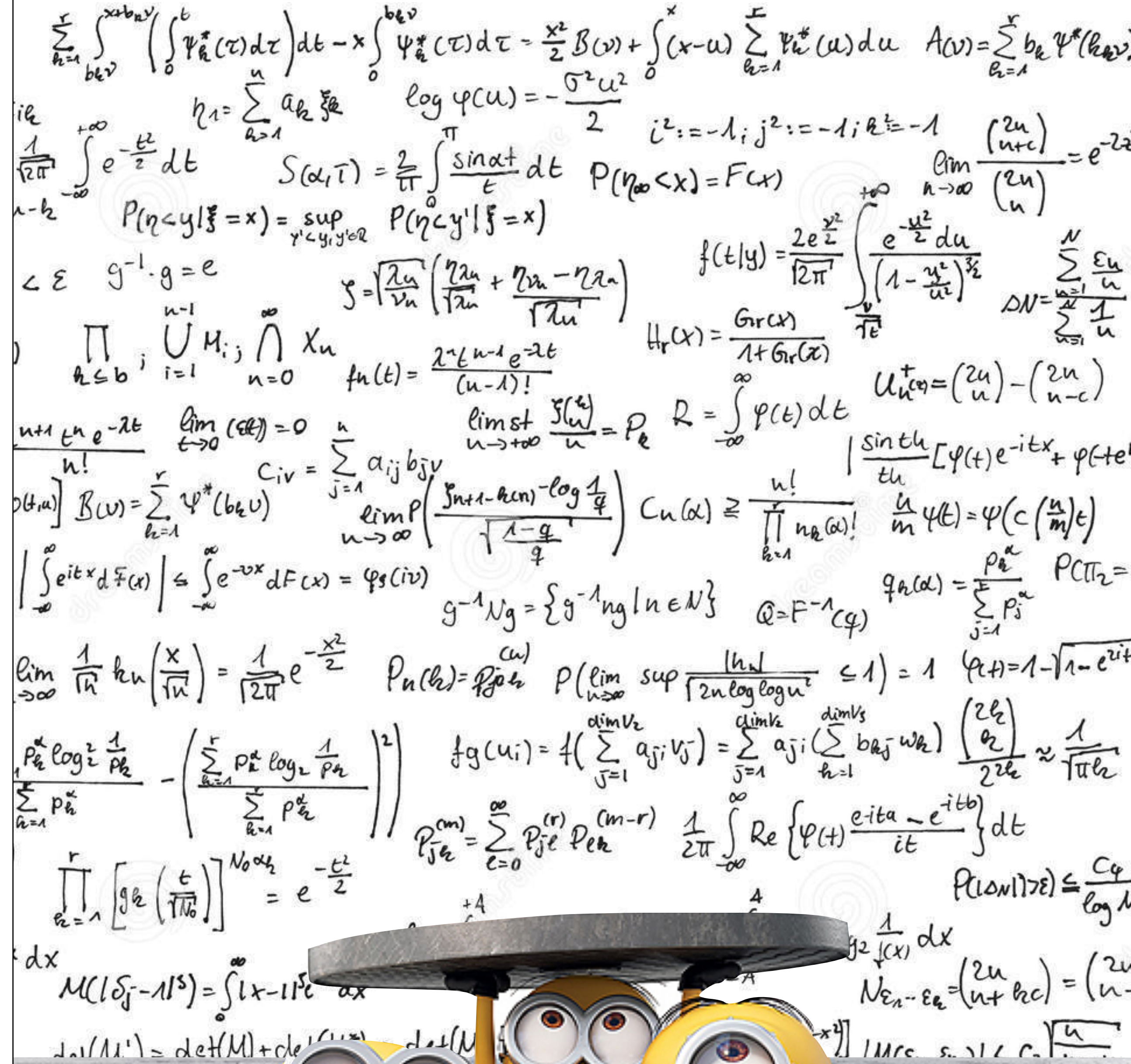
# Frequently Asked Questions

## What kind of research can I replicate?

Any computational research in any domain of science as long as there is an editor from the Board who has the expertise to edit your submission. The editorial board is growing to increase the scientific domains being covered. If no editor is able to edit your submission, you can also propose a guest editor (who must be willing to work with our GitHub-based editorial processes). about replication of my own work?

## I'm a student, can I submit?

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## CONCLUSION

# ReScience in numbers

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2 editors-in-chief  
10 associate editors  
90 registered reviewers  
17 published articles  
5 articles under review  
100% replication rate (strong bias)

ISSN 2430-3658  
SHERPA/RoMEO green access

Jan 20, 2017 | [Review](#) | [Repository](#) | DOI 10.5281/zenodo.254145

[\[Re\] Ionic Current Model of a Hypoglossal Motoneuron](#) - Shifman, Aaron, *ReScience*, volume 3, issue 1, 2017.

**Keywords:** neuroscience, Python, replication

Dec 9, 2016 | [Review](#) | [Repository](#) | DOI 10.5281/zenodo.200334

[\[Re\] How Attention Can Create Synaptic Tags for the Learning of Working Memories in Sequential Tasks](#) - Erwan Le Masson & Frédéric Alexandre, *ReScience*, volume 2, issue 1, 2016.

**Keywords:** neuroscience, deep learning, associative cortex, python

Oct 18, 2016 | [Review](#) | [Repository](#) | DOI 10.5281/zenodo.161526

[\[Re\] Cellular and network mechanisms of slow oscillatory activity \(<1 Hz\) and wave propagations in a cortical network model](#) - Andrei Maksimov, Sacha J. van Albada and Markus Diesmann, *ReScience*, volume 2, issue 1, 2016.

**Keywords:** Python, Neuroscience, NEST, Network Modeling, Up-Down Oscillations, Cortex, Membrane Resistance Measurement

Oct 7, 2016 | [Review](#) | [Repository](#) | DOI 10.5281/zenodo.159545

[\[Re\] Robust timing and motor patterns by taming chaos in recurrent neural networks](#) - Julien Vitay, *ReScience*, volume 2, issue 1, 2016.

**Keywords:** Python, Recurrent neural networks, Reservoir computing, Dynamical systems, Learning Chaos

Sep 7, 2016 | [Review](#) | [Repository](#) | DOI 10.5281/zenodo.61697

[\[Re\] Multiple dynamical modes of thalamic relay neurons: rhythmic bursting and intermittent phase-locking](#) - Georgios Detorakis, *ReScience*, volume 2, issue 1, 2016.

**Keywords:** Neuroscience, Python, Conductance-based model, Thalamic relay neurons, Intermittent phase-locking, Spindle oscillation, Delta oscillation

Apr 22, 2016 | [Review](#) | [Repository](#) | DOI 10.5281/zenodo.50213

[\[Re\] Chaos in a long-term experiment with a plankton community](#) - Owen Petchey, Marco Plebani, Frank Pennekamp, *ReScience*, volume 2, issue 1, 2016.

**Keywords:** Ecology, Forecasting, Prediction, Chaos, Nonlinear dynamics, Plankton community, Species interactions

Mar 7, 2016 | [Review](#) | [Repository](#) | DOI 10.5281/zenodo.47146

[\[Re\] Least-cost modelling on irregular landscape graphs](#) - Joseph Stachelek, *ReScience*, volume 2, issue 1, 2016.

**Keywords:** Ecology, Least-cost path, Delaunay triangulation, Graph Theory

Feb 10, 2016 | [Review](#) | [Repository](#) | DOI 10.5281/zenodo.45852

[\[Re\] Speed/accuracy trade-off between the habitual and the goal-directed process](#) - Guillaume Viejo, Benoît Girard & Mehdi Khamassi, *ReScience*, volume 2, issue 1, 2016.

**Keywords:** neuroscience, decision making, python

Aug 14, 2015 | [Review](#) | [Repository](#) | DOI 10.5281/zenodo.27944

[\[Re\] Interaction between cognitive and motor cortico-basal ganglia loops during decision making: a computational study](#) - Meropi Topalidou & Nicolas P. Rougier, *ReScience*, volume 1, issue 1, 2015.

**Keywords:** neuroscience, basal ganglia, python

## CONCLUSION

# What did we learn?

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We don't need money  
We don't need publishers  
We don't need buzz barrier  
We don't need authorisation  
We don't need impact factor  
We don't need to hide anything

We don't need much actually...  
Only time & support from the scientific community

But in the meantime we need to

- have better indexing (PubMed, Scopus, etc.)
- ensure short-term reproducibility (!)
- get some incentives from upper levels



WHAT'S NEXT?

# RESCIENCE<sup>X</sup>

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OPENING WINTER 2018

WHAT'S NEXT?

# COSCIENCE

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A UTOPIA FOR TOMORROW