

# Barriers to Open Research (and how to overcome them)



doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>  @kirstie\_j



- Research fellow at the Alan Turing Institute for Data Science
- Senior research associate in the Brain Mapping Unit, Department of Psychiatry, University of Cambridge
- 2016/17 Mozilla Fellow for Science



 @kirstie\_j

doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>

**SUPPORT  
THE STRIKE  
TO DEFEND  
USS**

**OUR  
PENSION  
AXED.**



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doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>

# Reproducible vs Replicable



doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>  @kirstie\_j

Code

Same

Different

Data

Same

Different



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doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>

Code

Same

Different

Reproducible

Data

Same

Different



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Same

Different

Reproducible

Replicable

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Same

Different



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Code

Data

Same

Different

Same

Reproducible

Replicable

Different

Robust



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Code

Data

Same

Different

Same

Reproducible

Replicable

Different

Robust

Generalisable



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# Barriers to reproducible research



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Is not considered  
for promotion

Requires  
additional skills

Plead the 5th

Support  
additional users

Takes time

# Barriers to reproducible research

Held to higher  
standards than  
others

Publication bias  
towards novel findings



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Is not considered  
for promotion

Requires  
additional skills

Plead the 5th

Support  
additional users

# Barriers to

Takes time

# reproducible research

Held to higher  
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Is not considered  
for promotion

Requires  
additional skills

Plead the 5th

Support  
additional users

**Barriers to**

Takes time

**reproducible research**

Held to higher  
standards than  
others

Publication bias  
towards novel findings



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doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>

# Aim for 50% comments in your code



doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>  @kirstie\_j

# Share your comments with the original author



doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>  @kirstie\_j

(which is almost  
always going to be  
YOU!)



 @kirstie\_j  
doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>



**Karen Cranston**

@kcranstn

 Follow

@mtholder motivating git: You mostly collaborate with yourself, and me-from-two-months-ago never responds to email. @swcarpentry

4:23 PM - Aug 23, 2013



28



19



\*\* It is embarrassing to me how often I forget not just details of experiments, but entire experiments. For example, for the manuscript I am working on now, I forgot that we had done an experiment to test for vertical transmission of the parasite. Fortunately, the undergrad who has been working on the project remembered and had it in his writeup!

<https://dynamicecology.wordpress.com/2015/02/18/the-biggest-benefit-of-my-shift-to-r-reproducibility>

<https://twitter.com/kcranstn/status/370914072511791104>



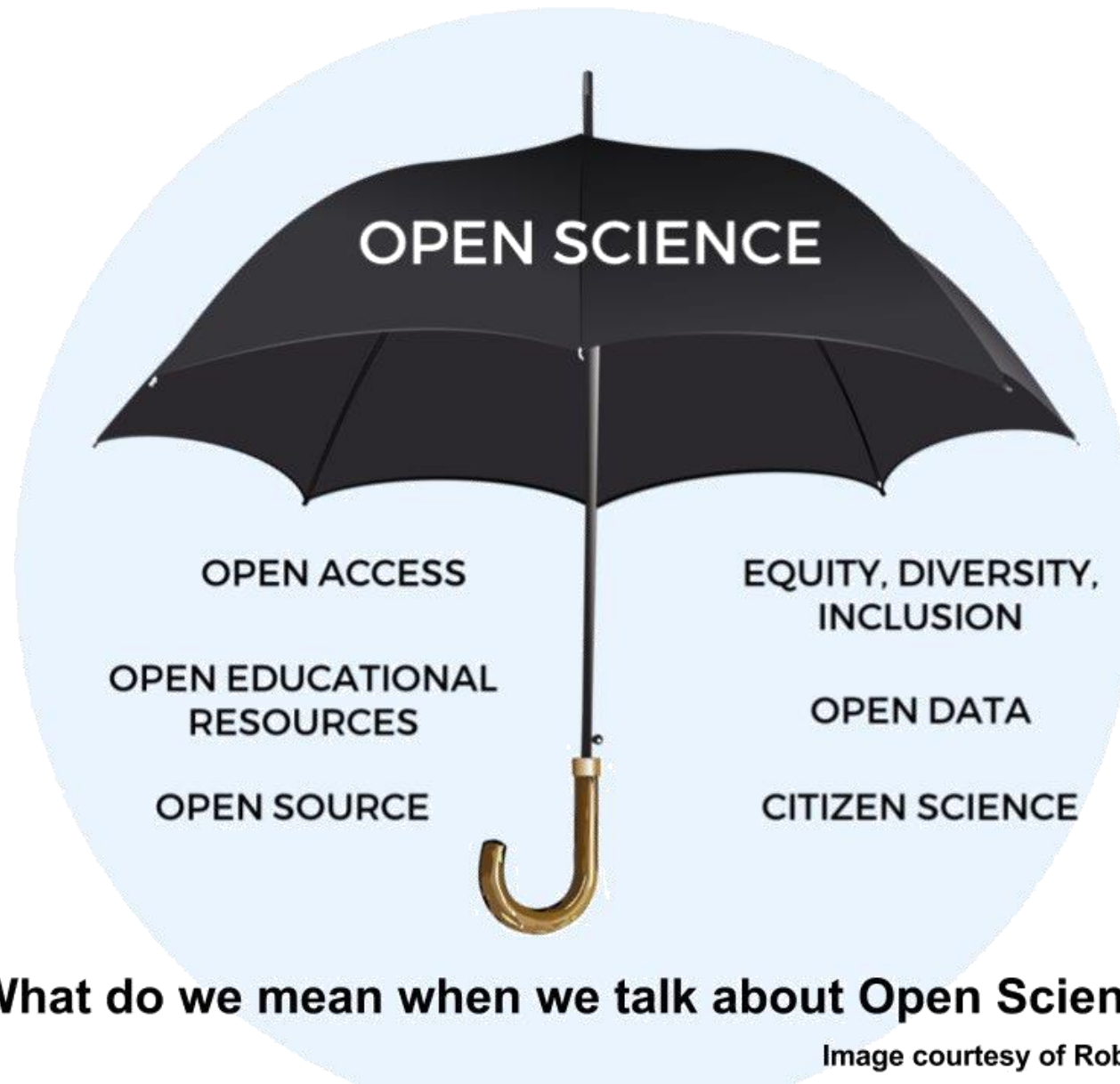
 @kirstie\_j

doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>

# Reproducible <> Open (and that's fine)



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## What do we mean when we talk about Open Science?

Image courtesy of Robin Champieux



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# Reproducible research at the Turing






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# The Alan Turing Institute





[Pull requests](#) [Issues](#) [Marketplace](#) [Explore](#)





**Martin O'Reilly**  
martintoreilly

Research Software Engineer at the UK's national data science institute.


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 The Alan Turing Institute

 London

**Organizations**





[Overview](#) [Repositories 10](#) [Stars 3](#) [Followers 2](#) [Following 0](#)

**Pinned repositories**


[alan-turing-institute/network-comparison](#)

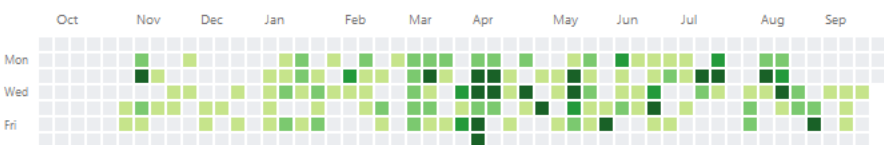
An R package implementing the NetEMD and NetDis network comparison measures

  3


[bif-lab](#)

A MATLAB library for efficiently generating Basic Image Features (BIFs) from images.



**815 contributions in the last year**


[Learn how we count contributions.](#)

Less  More

**Contribution activity** [Jump to](#)

2017


2016


 Created 18 commits in 3 repositories

[alan-turing-institute/science-gateway-middleware](#) 16 commits

[alan-turing-institute/common-crawl](#) 1 commit

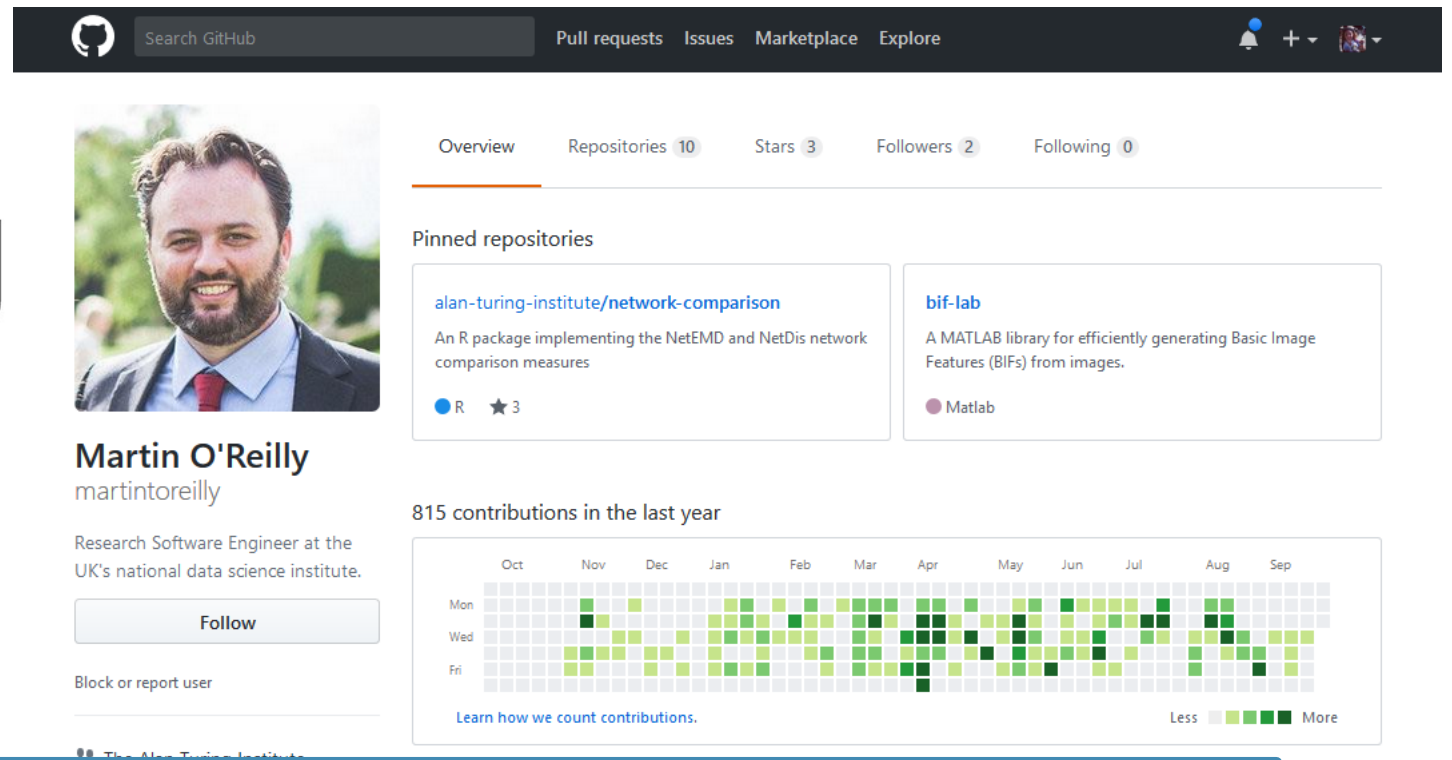
[alan-turing-institute/Hut23](#) 1 commit

 Created a pull request in alan-turing-institute/science-gateway-middleware that received 7 comments

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doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>

# The Alan Turing Institute



The screenshot shows the GitHub profile of Martin O'Reilly (martintoreilly). The profile includes a bio: "Research Software Engineer at the UK's national data science institute." and a "Follow" button. It also displays pinned repositories: "alan-turing-institute/network-comparison" (an R package) and "bif-lab" (a MATLAB library). A contribution graph shows 815 contributions in the last year, with a legend indicating the number of contributions per day (Less, More).

Search GitHub

Pull requests Issues Marketplace Explore

Overview Repositories 10 Stars 3 Followers 2 Following 0

**Pinned repositories**

- [alan-turing-institute/network-comparison](#)  
An R package implementing the NetEMD and NetDis network comparison measures  
R ★ 3
- [bif-lab](#)  
A MATLAB library for efficiently generating Basic Image Features (BIFs) from images.  
Matlab

**815 contributions in the last year**

Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep

Mon  
Wed  
Fri

Learn how we count contributions.

Less More

My colleagues in the research software engineering team and I **seek to position The Alan Turing Institute as a world leader for reproducible research** by embedding a culture of “reproducible by default” at the institute and providing training and tools to make reproducible research “too easy not to do”.



2017  
2016

Comments

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# Reproducible research at the Turing

- Training & support for incoming students
- Software development support
  - From the beginning if possible
  - Posthoc for now
- Turing Reproducibility Champions
- Institutional buy in



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doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>

# Reproducible research at the Turing

- Training & support for incoming students
- Software development support
  - From the beginning if possible
  - Posthoc for now
- Turing Reproducibility Champions
- Institutional buy in
- “The Turing Way”



Attr: edhiggins, CC BY 3.0, via Wikimedia Commons

# Find what works for you



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# Find what works for you

*Every little helps*



doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>  @kirstie\_j





**DATA**  
**CARPENTRY**  
|||||||

  
**software**  
**carpentry**

# You can do this!

<https://www.mozillascience.org>

<http://software-carpentry.org>

<http://data-carpentry.org>

<https://www.coursera.org/specializations/jhu-data-science>

<https://www.coursera.org/learn/python/home/info>



 @kirstie\_j

doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>





**DATA**  
**CARPENTRY**  
|||||||

  
**software**  
**carpentry**

# WE can do this!

<https://www.mozillascience.org>

<http://software-carpentry.org>

<http://data-carpentry.org>

<https://www.coursera.org/specializations/jhu-data-science>

<https://www.coursera.org/learn/python/home/info>



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# The Alan Turing Institute



UNIVERSITY OF  
CAMBRIDGE

# Thank you!



WhitakerLab



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# Start small



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# Protocols.io



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✓ UCHANGE structural neuroimaging pipeline

90%

Search

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protocols.io

DISCOVERMY PROTOCOLSKirstie

Home > researchers > Kirstie Whitaker > protocols > UCHANGE structural neuroimaging pipeline

VIEWING PROTOCOL

STEPSDESCRIPTIONGUIDELINES & WARNINGSCOMMENTSRESULTSMOREMETRICSETTINGS

1

Check or complete software installation You must...

2

Set up your .bashrc file NOTE: The image for...

3

Set up directory structure You must have the...

4

Put the fsaverageSubP folder in the SUB\_DATA..

5

Mask background and brain extract MPM images...

6

Run Freesurfer's Recon all command Next

PREVIEW

RUN

NEW VERSION

FORK

MANUSCRIPT CITATION

TRANSFER

MORE ACTIONS

UCHANGE structural neuroimaging pipeline

Kirstie Whitaker<sup>1</sup>

<sup>1</sup> Brain Mapping Unit, Department of Psychiatry, University of Cambridge  
10.17504/protocols.io.eu5bey6

Steps

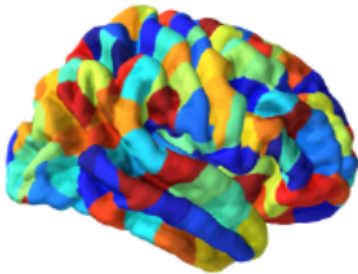
1 Check or complete software installation

You must have the following software libraries installed:


- **Freesurfer:** <https://surfer.nmr.mgh.harvard.edu/fswiki/DownloadAndInstall>
- **FSL:** <http://fsl.fmrib.ox.ac.uk/fsl/fslwiki/FslInstallation>
- **Anaconda:** <https://www.continuum.io/downloads>

From within **Anaconda** install the following python packages following the command below:

- [VTK](#)
- [Mayavi](#)
- [Nibabel](#)
- [pysurfer](#)



CONTACT

 **Kirstie Whitaker**

169 Views

14 Steps

1 Bookmark

Help

UCHANGE structural neuroi

+

https://www.protocols.io/view/uchange-structural-neuroimaging-pipeline-eu5bey6?st

90%

Search

☆

📁

⬇️

🏠

🛡️

🌈

✂️

🔴

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☰

protocols.io


🔍

DISCOVER

MY PROTOCOLS

+

Kirstie



Home > researchers > Kirstie Whitaker > protocols > UCHANGE structural neuroimaging pipeline

VIEWING PROTOCOL

STEPS

DESCRIPTION

GUIDELINES & WARNINGS

COMMENTS

RESULTS

MORE

METRICS

SETTINGS

📄

PREVIEW

RUN

NEW VERSION

FORK ↗️

MANUSCRIPT CITATION

TRANSFER 👤

MORE ACTIONS

# UCHANGE structural neuroimaging pipeline

Kirstie Whitaker<sup>1</sup>

<sup>1</sup> Brain Mapping Unit, Department of Psychiatry, University of Cambridge  
10.17504/protocols.io.eu5bey6

## Steps

1

Check or complete software installation You must...

2

Set up your .bashrc file  
NOTE: The image for...

3

Set up directory structur  
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6

Run Freesurfer's Recon  
all command Next

1

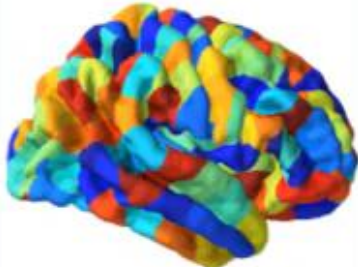
Check or complete software installation

You must have the following software libraries installed:


- **Freesurfer:** <https://surfer.nmr.mgh.harvard.edu/fswiki/DownloadAndInstall>
- **FSL:** <http://fsl.fmrib.ox.ac.uk/fsl/fslwiki/FslInstallation>
- **Anaconda:** <https://www.continuum.io/downloads>

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- [Nibabel](#)
- [pysurfer](#)



CONTACT

 **Kirstie Whitaker**

👁️

169 Views

📄

14 Steps

📖

1 Bookmark

🔍

Help

# Asking for help: StackOverflow & MWEs

<http://stackoverflow.com>



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[https://mrcolley.com/2014/07/01/  
talk-to-the-duck-debugging-and-resilience](https://mrcolley.com/2014/07/01/talk-to-the-duck-debugging-and-resilience)



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# Version Control



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# "FINAL".doc



FINAL.doc!



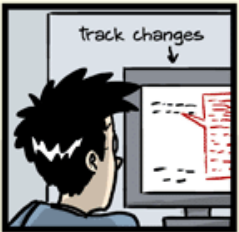
FINAL\_rev.2.doc



FINAL\_rev.6.COMMENTS.doc



FINAL\_rev.8.comments5.  
CORRECTIONS.doc



FINAL\_rev.18.comments7.  
corrections9.MORE.30.doc



FINAL\_rev.22.comments49.  
corrections.10.##\$%WHYDID  
ICOMETOGRADSCHOOL????.doc



# "FINAL".doc



FINAL.doc!



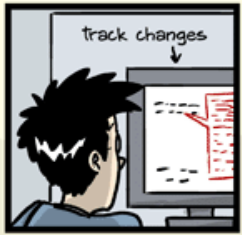
FINAL\_rev.2.doc



FINAL\_rev.6.COMMENTS.doc



FINAL\_rev.8.comments5.  
CORRECTIONS.doc



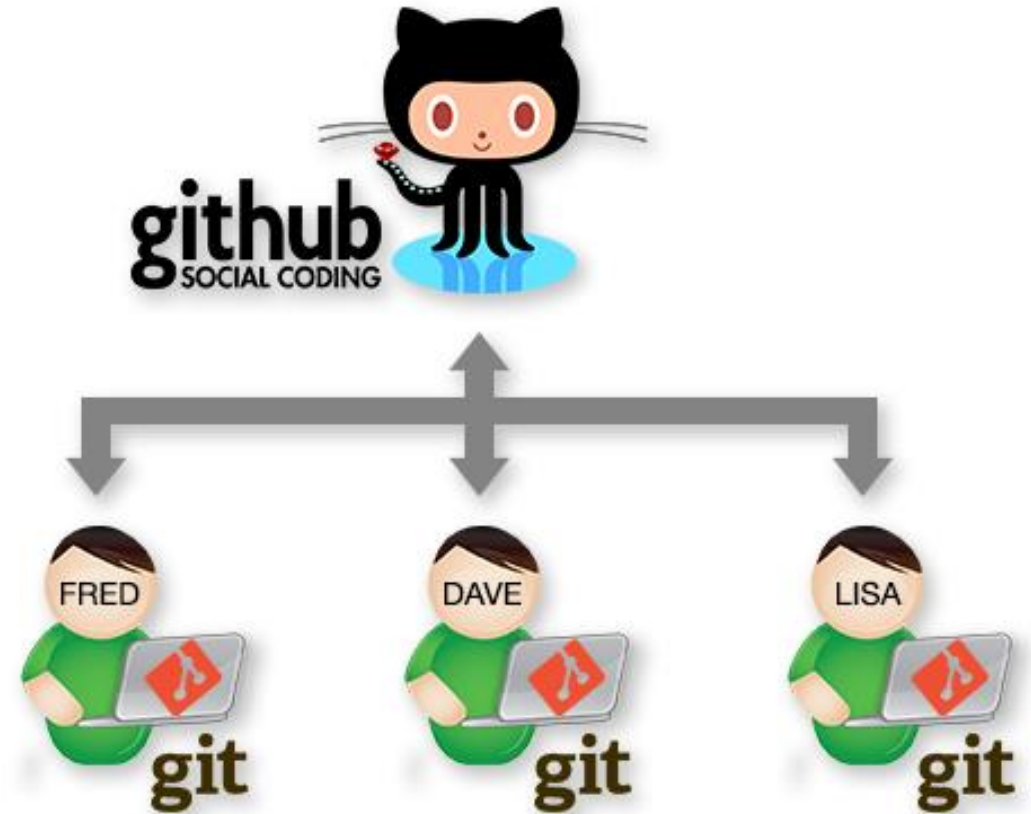
FINAL\_rev.18.comments7.  
corrections9.MORE.30.doc



FINAL\_rev.22.comments49.  
corrections.10.##\$%WHYDID  
ICOMETOGRADSCHOOL?????.doc

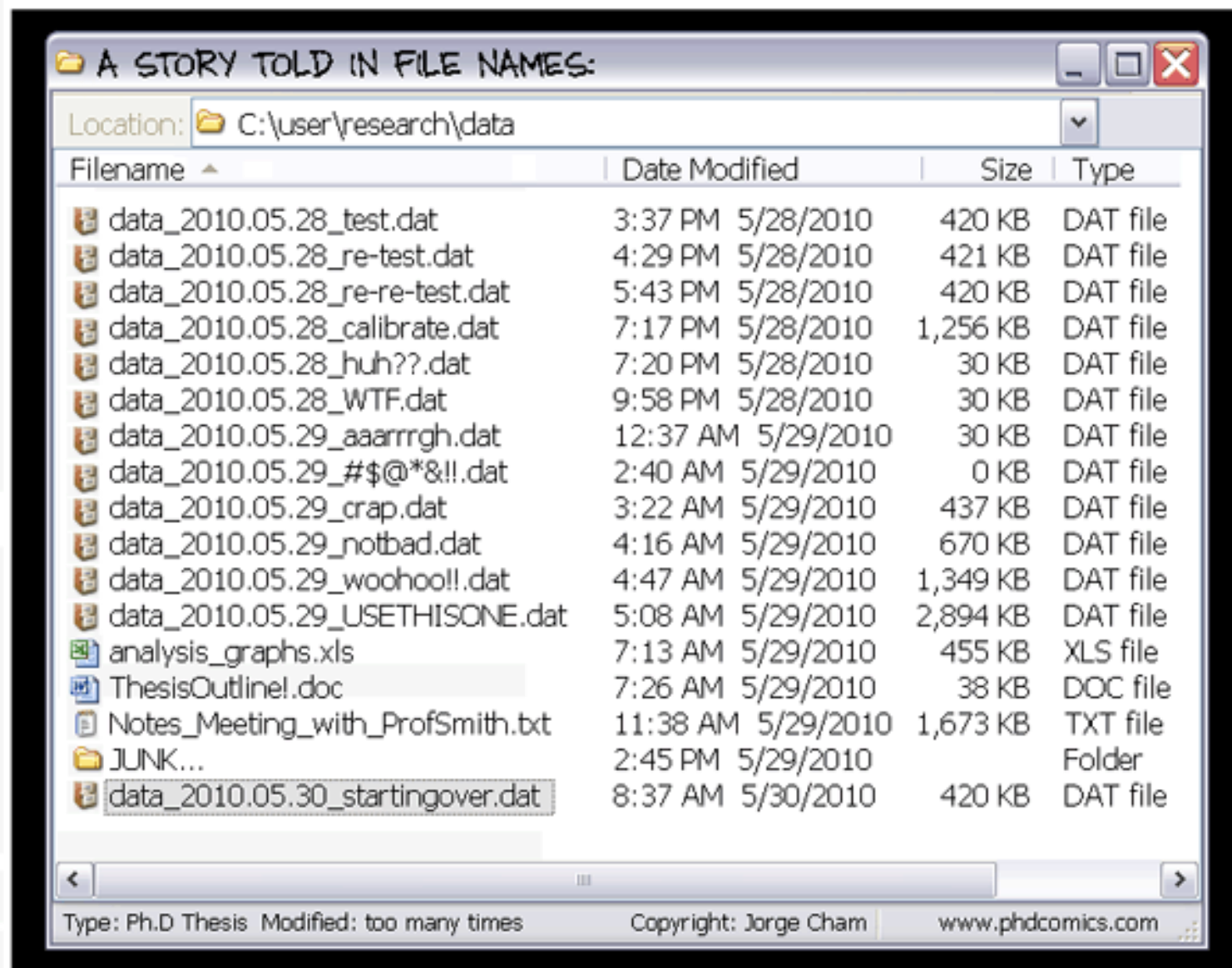
WWW.PHDCOMICS.COM

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# Python vs R

(vs Matlab vs STATA etc...)



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RStudio

File Edit Code View Plots Session Build Debug Tools Help

Go to file/function

Project: (None)

Environment History

Files Plots Packages Help Viewer

The R Language Find in Topic

Statistical Data Analysis

Manuals

Reference

Console

```
> mean(c(1, 2, 5))
[1] 2.666667
```

198 observations of 8 variables

	column1	column2	column3	column4	column5
1	training	1	right	leftresponse	incompati
2	training	2	right	rightresponse	compatibl
3	training	2	right	rightresponse	compatibl
4	training	0	left	leftresponse	compatibl
5	training	1	right	leftresponse	incompati
6	training	1	right	leftresponse	incompati
7	training	2	right	rightresponse	compatibl
8	block1	1	right	leftresponse	incompati
9	block1	2	right	rightresponse	compatibl

[An Introduction to R](#) [The R Language Definition](#)

[Writing R Extensions](#) [R Installation and Administration](#)

[R Data Import/Export](#) [R Internals](#)

[Packages](#) [Search Engine & Keywords](#)

RStudio

File Edit Code View Project Workspace Plots Tools Help

Go to file/function

Project: (None)

Workspace History

Load Save Import Dataset Clear All

Data

diamonds 53940 obs. of 10 variables

Values

aveSize 0.7979

clarity character[8]

p ggplot[8]

Functions

format.plot(plot, size)

Files Plots Packages Help

Zoom Export Clear All

Diamond Pricing

Price

Carat

Clarity

- I1
- SI2
- SI1
- VS2
- VS1
- VVS2
- VVS1
- IF

```
1 library(ggplot2)
2 source("plots/formatPlot.R")
3
4 View(diamonds)
5 summary(diamonds)
6
7 summary(diamonds$price)
8 aveSize <- round(mean(diamonds$carat), 4)
9 clarity <- levels(diamonds$clarity)
10
11 p <- qplot(carat, price,
12            data=diamonds, color=clarity,
13            xlab="Carat", ylab="Price",
14            main="Diamond Pricing")
15
```

Console

```
Min. x: 0.000 Min. y: 0.000 Min. z: 0.000
1st Qu.: 4.710 1st Qu.: 4.720 1st Qu.: 2.910
Median : 5.700 Median : 5.710 Median : 3.530
Mean : 5.731 Mean : 5.735 Mean : 3.539
3rd Qu.: 6.540 3rd Qu.: 6.540 3rd Qu.: 4.040
Max. :10.740 Max. :58.900 Max. :31.800
> summary(diamonds$price)
Min. 1st Qu. Median Mean 3rd Qu. Max.
326 950 2401 3933 5324 18820
> aveSize <- round(mean(diamonds$carat), 4)
> clarity <- levels(diamonds$clarity)
> p <- qplot(carat, price,
+            data=diamonds, color=clarity,
+            xlab="Carat", ylab="Price",
+            main="Diamond Pricing")
> format.plot(p, size=24)
>
```



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OVERVIEW

TUTORIAL

ARTICLES

GALLERY

REFERENCE

DEPLOY

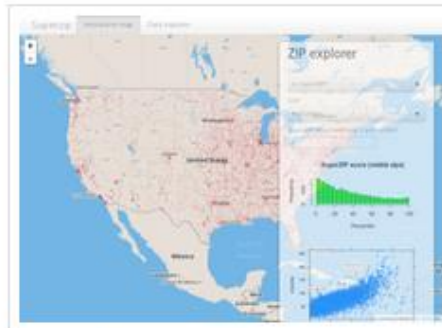
HELP

# Gallery

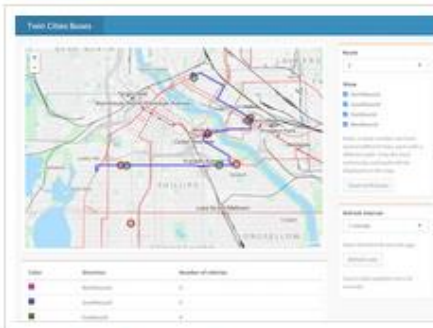
This gallery contains useful examples to learn from. Visit the [Shiny User Showcase](#) to see an inspiring set of sophisticated apps.

## Interactive visualizations

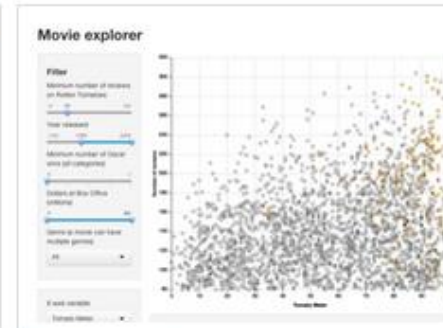
Shiny is designed for fully interactive visualization, using JavaScript libraries like [d3](#), [Leaflet](#), and [Google Charts](#).



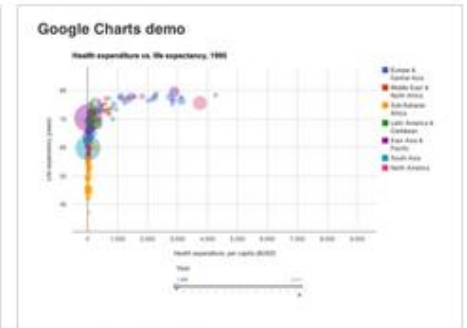
SuperZip example



Bus dashboard



Movie explorer



Google Charts

## Shiny gallery

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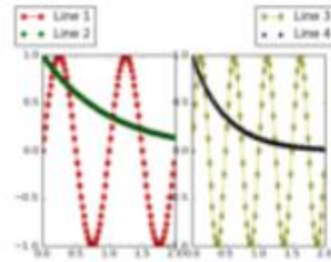


doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>  @kirstie\_j

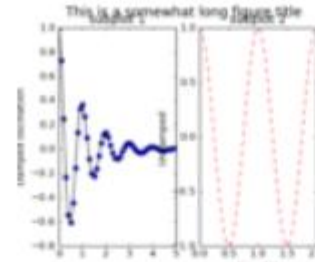


# Matplotlib gallery

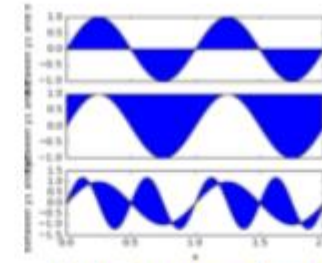
Click each  
example to see  
source code



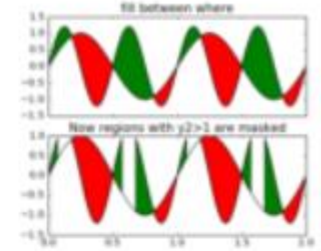
figlegend\_demo



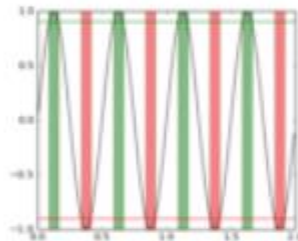
figure\_title



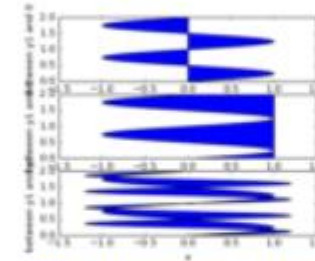
fill\_between\_demo



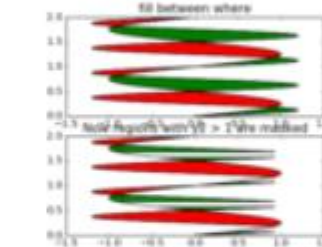
fill\_between\_demo



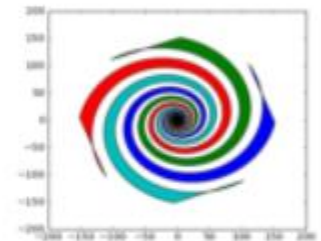
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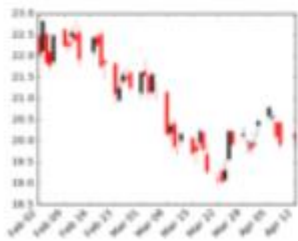
fill\_betweenx\_demo



fill\_betweenx\_demo



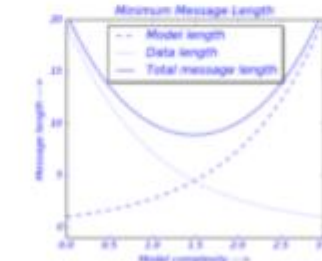
fill\_spiral



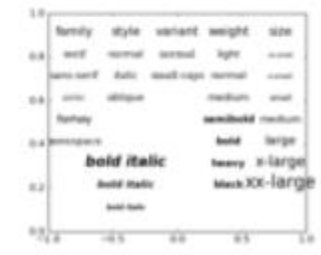
finance\_demo



finance\_work2



findobj\_demo

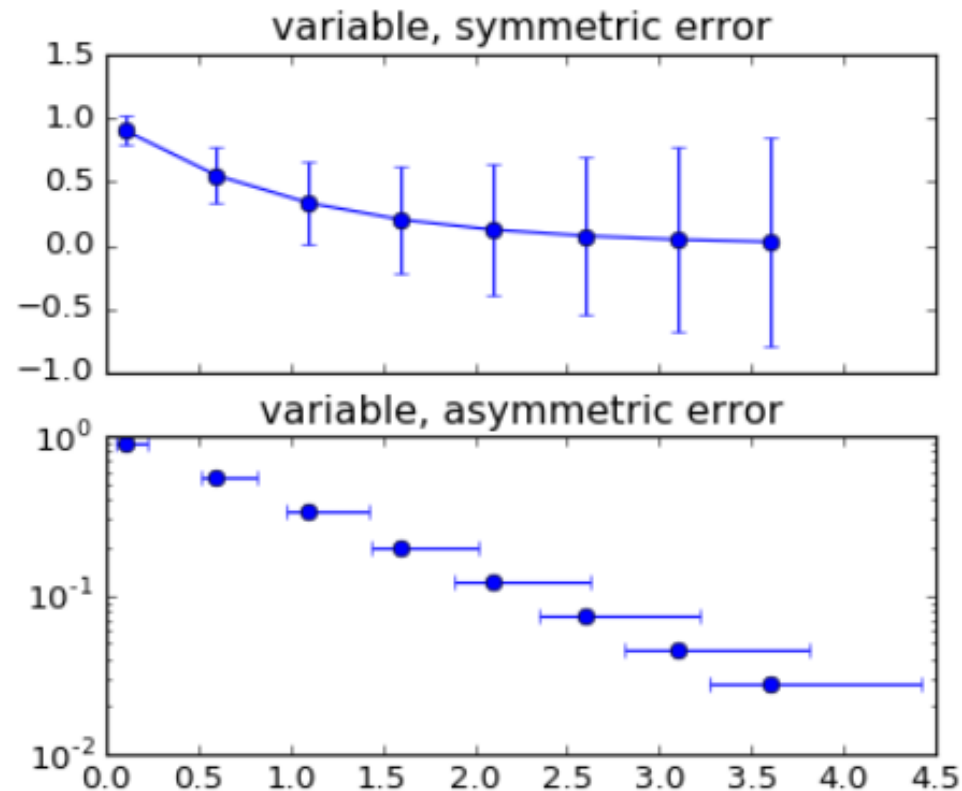


fonts\_demo



# statistics example code: errorbar\_demo\_features.py

(Source code, png, hires.png, pdf)



```
"""
Demo of errorbar function with different ways of specifying error bars.

Errors can be specified as a constant value (as shown in `errorbar_demo.py`),
or as demonstrated in this example, they can be specified by an  $N \times 1$  or  $2 \times N$ ,
where  $N$  is the number of data points.
```

```
 $N \times 1$ :
    Error varies for each point, but the error values are symmetric (i.e. the
    lower and upper values are equal).

 $2 \times N$ :
    Error varies for each point, and the lower and upper limits (in that order)
    are different (asymmetric case)
```

```
In addition, this example demonstrates how to use Log scale with errorbar.
"""
```

```
import numpy as np
import matplotlib.pyplot as plt

# example data
x = np.arange(0.1, 4, 0.5)
y = np.exp(-x)

# example error bar values that vary with x-position
error = 0.1 + 0.2 * x
# error bar values w/ different +/- errors
lower_error = 0.4 * error
upper_error = error
asymmetric_error = [lower_error, upper_error]

fig, (ax0, ax1) = plt.subplots(nrows=2, sharex=True)
ax0.errorbar(x, y, yerr=error, fmt='o')
ax0.set_title('variable, symmetric error')

ax1.errorbar(x, y, xerr=asymmetric_error, fmt='o')
ax1.set_title('variable, asymmetric error')
ax1.set_yscale('log')
plt.show()
```



[http://matplotlib.org/examples/statistics/errorbar\\_demo\\_features.html](http://matplotlib.org/examples/statistics/errorbar_demo_features.html)

doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>

@kirstie\_j

# Jupyter Notebook



<http://jupyter.org>



doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>  @kirstie\_j

# 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/s/events/GW150914/GW150914\\_tutorial.html](https://losc.ligo.org/s/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 iPython 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. You can run the python script GW150914\_tutorial.py. You will need the python packages:

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

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

v20160208b

[https://losc.ligo.org/s/events/GW150914/GW150914\\_tutorial.html](https://losc.ligo.org/s/events/GW150914/GW150914_tutorial.html)

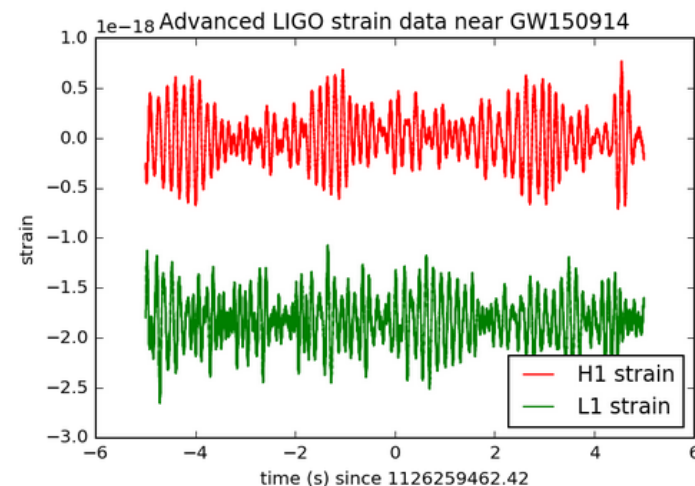
  
Observation of Gravitational Waves from a Binary Black Hole Merger

B. P. Abbott *et al.*\*  
(LIGO Scientific Collaboration and Virgo Collaboration)  
(Received 21 January 2016; published 11 February 2016)



```
In [6]: # plot +/- 5 seconds around the event:
tevent = 1126259462.422          # Mon Sep 14 09:50:45 GMT 2015
deltat = 5.                      # seconds around the event
# index into the strain time series for this time interval:
indxt = np.where((time_H1 >= tevent-deltat) & (time_H1 < tevent+deltat))

plt.figure()
plt.plot(time_H1[indxt]-tevent, strain_H1[indxt], 'r', label='H1 strain')
plt.plot(time_L1[indxt]-tevent, strain_L1[indxt], 'g', label='L1 strain')
plt.xlabel('time (s) since '+str(tevent))
plt.ylabel('strain')
plt.legend(loc='lower right')
plt.title('Advanced LIGO strain data near GW150914')
plt.savefig('GW150914_strain.png')
```



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# Submit your first pull request!

Inspired by: <https://yourfirstpr.github.io>



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# ReproducibleResearch

---

This repository supports [Kirstie's](#) presentation on tips and tricks for making your research reproducible.

The goal is to build a directory of useful links, and a jargon busting glossary.

## Guide for contributors

---

See our [guidelines](#) for how to contribute to the project.

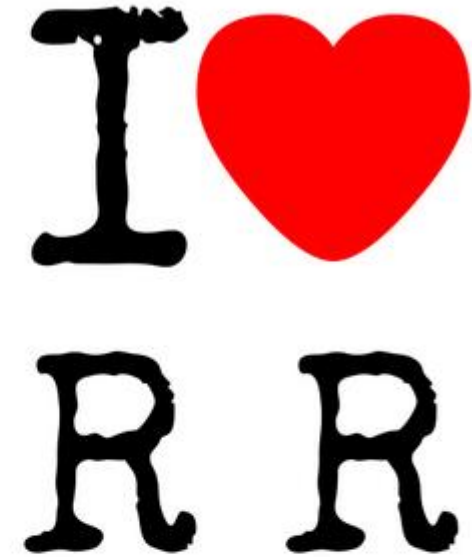
## Code of conduct

---

Everyone is welcome to join this project, particularly people who have not used GitHub before and are feeling unsure of how to begin!



Please follow our [code of conduct](#) in all your on and offline interactions.



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doi: <https://dx.doi.org/10.6084/m9.figshare.5914444>  [@kirstie\\_j](https://twitter.com/kirstie_j)

# Aim for 40% comments in your code



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(which is almost  
always going to be  
YOU!)



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Our fourth cohort of Mozilla Open Leaders starts in September 201...  
Health movement by engaging more contributors in their work and

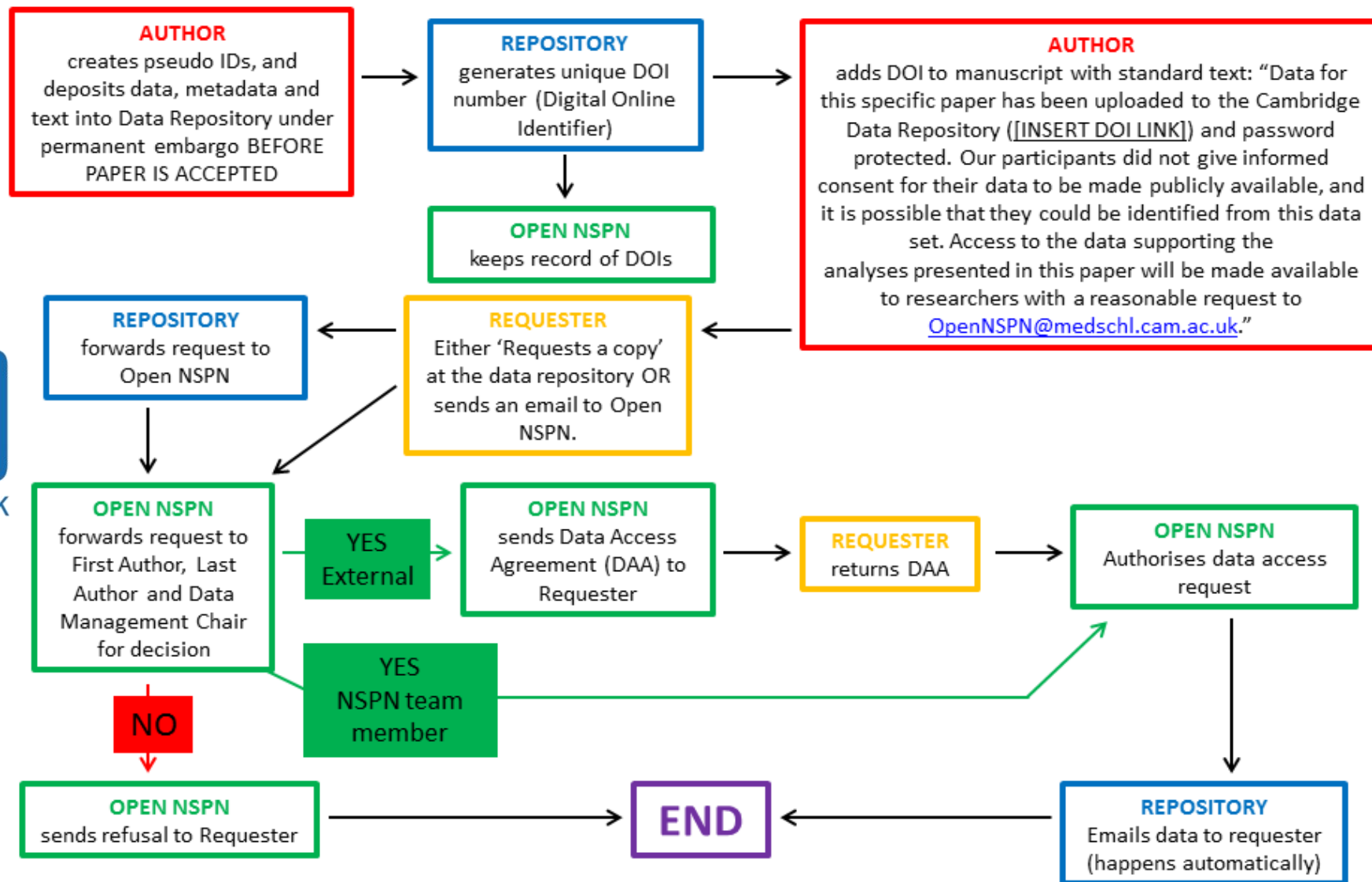
<https://mozilla.github.io/leadership-training>

# What if I can't (ever) share my data?



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## Adolescent Tuning Of Association Cortex In Human Structural Brain Networks

František Váša, Jakob Seidlitz, Rafael Romero-Garcia, Kirstie J. Whitaker, Gideon Rosenthal, Petra E. Vértes, Maxwell Shinn, Aaron Alexander-Bloch, Peter Fonagy, Raymond J. Dolan, Peter B. Jones, Ian M. Goodyer, The NSPN Consortium, Olaf Sporns, Edward T. Bullmore

doi: <https://doi.org/10.1101/126920>

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How does human brain organization change over the course of adolescence? Motivated by prior data on local cortical shrinkage and intracortical myelination, we predicted age-related changes in topological organisation of cortical structural networks. We estimated the structural correlation matrix from magnetic resonance imaging (MRI) measures of cortical thickness at 308 regions in a sample of N=297 healthy participants, aged 14-24 years (inclusive). We used

### Subject Area

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## Availability of data and code

Data for this specific paper has been uploaded to the Cambridge Data Repository (<https://doi.org/10.17863/CAM.8856>) and password protected. Our participants did not give informed consent for their questionnaire measures to be made publicly available, and it is possible that they could be identified from this data set. Access to the data supporting the analyses presented in this paper will be made available to researchers with a reasonable request to [NSPNdata@medschl.cam.ac.uk](mailto:NSPNdata@medschl.cam.ac.uk). The code used to conduct analyses is available from FV's github: [https://github.com/frantisekvasa/structural\\_network\\_development](https://github.com/frantisekvasa/structural_network_development) (DOI: 10.5281/zenodo.528674).

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Adolescent

František Váša  
Petra E. Vértes  
Peter B. Jones  
doi: <https://doi.org/10.1101/2021.03.11.432811>

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Abstract

Abstract

How does  
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There are two files supporting this publication. The first is an RData file containing all variables necessary to reproduce the main findings of the publication. The second is a Microsoft Word document describing 1) how the data was collected and processed and 2) all the variables stored in the RData file.

### Software

Custom scripts written in R, available from Frantisek Vasa's github page: [https://github.com/frantisekvasa/structural\\_network\\_development](https://github.com/frantisekvasa/structural_network_development) (DOI: 10.5281/zenodo.528674)

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Váša et al, 2017





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For details regarding the motivation behind analyses and the interpretation of results, see the manuscript.

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František Váša

Initial release of the code supporting the manuscript "Adolescent tuning of association cortex in human structural brain networks" by František Váša et al.

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Publication date:

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DOI 10.5281/zenodo.528674


Related identifiers:

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[https://github.com/frantisekvasa/structural\\_network\\_development/tree/v0.1](https://github.com/frantisekvasa/structural_network_development/tree/v0.1)

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