Urban Informatics

Fall 2018

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 @fedhere 

Urban Informatics

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Urban Informatics

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astrophysicist

http://blogs.teradata.com/international/sciences-loss-gain-data-science/

CUSP

CUSP

Urban Observatory

Data Science Institute - Inaugural event

what is data science? we have been using data in science the whole time, but with the volume, rate, and complexity of the current data we have to worry about things that we would neglect until now: what happens if our data has errors, what happens if we have missing data?

Lue Rossi, Mathematical Sciences Chairperson, UD

(astrophysicists have always worried about that)

CUSP

Understand Your Data

Urban Informatics

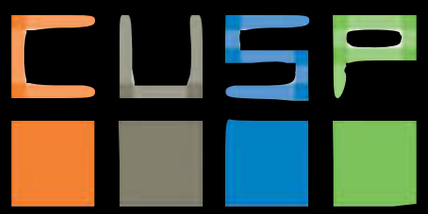
Class website:
serv.cusp.nyu.edu/~fbianco/PUI2018

Urban Informatics

Class: 3 hours, lecture + lab

Grade

- *5% on pre-class question*
- 10 % class performance and participation
- 25 % homework
- 25 % midterm
- 35 % final



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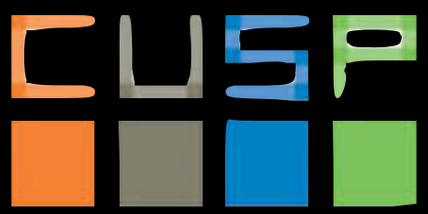
from beginning of class to 5 minutes past the hour (be on time!)
questions on previous class material AND READING ASSIGNMENTS



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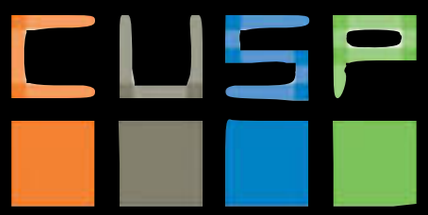
ask questions

answer questions

get up and code

extra credit assignments



Urban Informatics

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Homework projects must be turned in as iPython notebooks by checking them into your github account in the PUI2018_<netID> repo and the project directories HW<hw number>_<netID> (unless otherwise stated). <nyuid> is e.g. fb55

Urban Informatics

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- 25 % homework
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- 35 % final

I encourage you to work in groups! but as a collaborative project where different group members lead different aspects of the work.
A statement to describing your contribution to the project MUST be included in the README (a la *Nature Magazine*).

Light echoes reveal an unexpectedly cool η Carinae during its nineteenth-century Great Eruption

A. Rest, J. L. Prieto, N. R. Walborn, N. Smith, F. B. Bianco, R. Chornock, D. L. Welch, D. A. Howell, M. E. Huber, R. J. Foley, W. Fong, B. Sinnott, H. E. Bond, R. C. Smith, I. Toledo, D. Minniti & K. Mandel

Affiliations Contributions

Nature 482, 375–378 (16 Fe
Received 26 August 2011
Brief Communication Arisi

Contributions

All authors contributed to the drafting of the paper. A.R., N.S. and R.C.S. imaged the area around η Car. A.R. and M.E.H. reduced the imaging data. H.E.B. provided images of the echoes that guided our spectroscopic pointings. J.L.P., R.C., R.J.F. and W.F. obtained the spectra and reduced them. A.R. and J.L.P. performed spectral analysis and interpretation. A.R., N.R.W. and F.B.B. performed spectral classification. F.B.B. and K.M. correlated the spectra. A.R., D.L.W. and B.S. modelled the light echo. I.T. and D.M. provided imaging of η Car. F.B.B. and D.A.H. provided the FTS images, and F.B.B. and A.R. reduced them.

Class: 3 hours, lecture + lab

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- 25 % homework
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A statement to describing your contribution to the project MUST be included in the README (a la *Nature Magazine*).

Example of a README.md for a PUI homework: missing the README.md costs you 10% of the grade!

The README.md is a MarkDown (md) file. The syntax of a MarkDown is rather simple: https://github.com/adam-p/markdown-here/wiki/Markdown-Cheatsheet. Also the MD syntax can be used in Jupiternotebook cells to include text (not code) that is automatically formatted (which you will need to do over and over…)

CitiBike HW - v1

Question

Are CitiBike's easing commuter journey's across the East River?

Hypothesis

- H0: The probability of a citibike subscriber crossing the East River in a given month is **independent** of whether the trip is taken during rush hour
- H1: The probability of a citibike subscriber crossing the East River in a given month is **not independent** of whether the trip is taken during rush hour

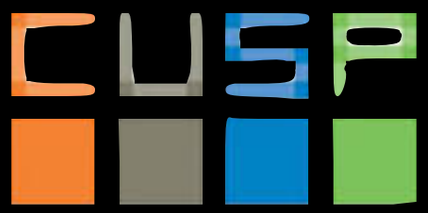
Project work balance

hypothesis generation

Max, Arno, Clayton discussed and equally shared hypothesis generation. Max had the original idea of looking at bridges as he is an avid CitiBike user

Tasks

1. Clayton is tagging trips as cross east river or not
2. Max is defining historic hours as "on peak" or "not on peak"
3. Arno completes a chi-square test of our hypothesis



Urban Informatics

Class: lecture + lab

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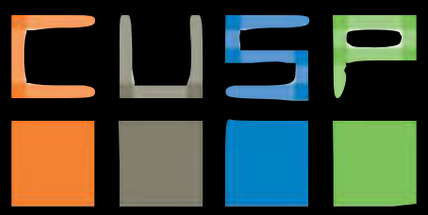
After the midterm projects we might have code reviewed by your peers.
We'll have 1 multi-week homework project from proposal to peer review.
https://blog.fogcreek.com/increase-defect-detection-with-our-code-review-checklist-example/



Class: lecture + lab

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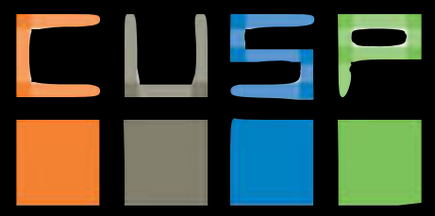
Midterm and Final will include aspects of the work developed in the homework sessions.
Failing to actively participate in the homework will result in not being able to get the Midterm and Final done.

Class:
Grade

- 5%
- 10
- 25
- 25
- 35



This repository Search Pull requests Issues Gist

fedhere / PUI2016_fb55

Unwatch 1 Star 0 Fork 0

Code Issues 0 Pull requests 0 Wiki Pulse Graphs Settings

No description or website provided. — Edit

61 commits 1 branch 0 releases 1 contributor

Branch: master New pull request Create new file Upload files Find file Clone or download

fedhere committed on GitHub Update README.md Latest commit a183019 2 minutes ago

HW1_fb55	Update README.md	21 hours ago
Lab1_fb55	Delete github_create_repo_cmds.md	21 hours ago
PEP8MinimalRequirements.md	Update PEP8MinimalRequirements.md	an hour ago
README.md	Update README.md	2 minutes ago

README.md

PUI2016_fb55

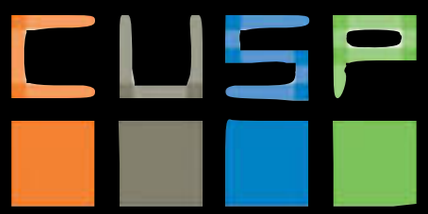
This repository contains the assignments for NYU CUSP Principles of Urban Informatics 2016. Check here for the new assignments, and for the solutions to be posted.

GRADING GUIDELINES

- Each HW must be turned in as a directory in PUI2016_<netID>.
- The directory HW<hw_number>_<netID> must have a README.md which who was in the group that the student worked in and states the student's participation. No penalty if the student declairs not to have had any contribution but to have jut followed and learned. However **missing the README.md, missing the statement about who the student worked with and what they did, or inconsistencies between the statements of students within the group that cannot be easily reconceiled by asking will costs them 10% of the grade.**
- Each assignment turned in as a notebook must have rendered plots with axis labels and captions. **Each missing/non rendered plot, or plot without axes labels or caption will cost 10% of the grade.**
- The notebook must be executables: the TA must downlad the notebook and run it cell by cell without errors. If

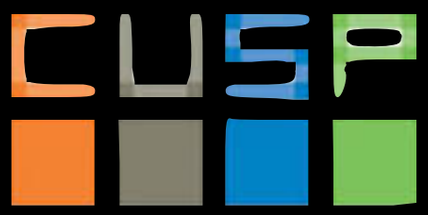
Urban Informatics

GOALS



The workflow of a data driven project

- IDEA
- dataset
  - define ideal data
  - figure out best data available
  - figure out if you can get new data
  - obtain data (including policy issues + technical issues)
- data handling
  - joining databases
  - formatting data
- exploratory data analysis
  - machine learning (clustering? dimensionality reduction?)
- statistics
  - models (regression)
  - prediction
  - validation (simulations)
- interpretation
- presentation
  - visualization
  - write a paper!



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- statistics
  - models (regression)
  - prediction
  - validation (simulations)
- interpretation
- presentation
  - visualization
  - write a paper or give a talk

CUSP

The philosophical side of things

CUSP

I: Good scientific practice
& work flow

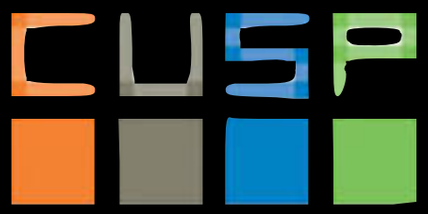
what is a scientific theory?

I: Good scientific practice
& work flow

The Demarcation Problem: a scientific theory must be *falsifiable*

My proposal is based upon an *asymmetry* between verifiability and **falsifiability**; an asymmetry which results from the logical form of universal statements. For these are never derivable from singular statements, but can be contradicted by singular statements.

—Karl Popper, *The Logic of Scientific Discovery*



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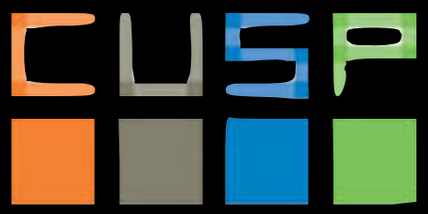
things can get more complicated though:

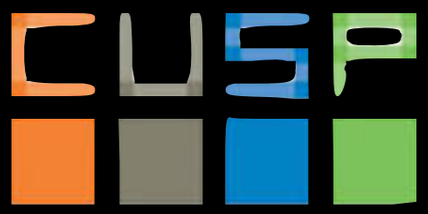
most scientific theories are actually based largely on *probabilistic induction* and modern *inductive inference* (Solomonoff, frequentist vs Bayesian methods...)



Ockham's razor: ***Pluralitas non est ponenda sine neccesitate***
or "the law of parsimony"

William of Ockham (logician and Franciscan friar) 1300ca
but probably to be attributed to John Duns Scotus (1265–1308)

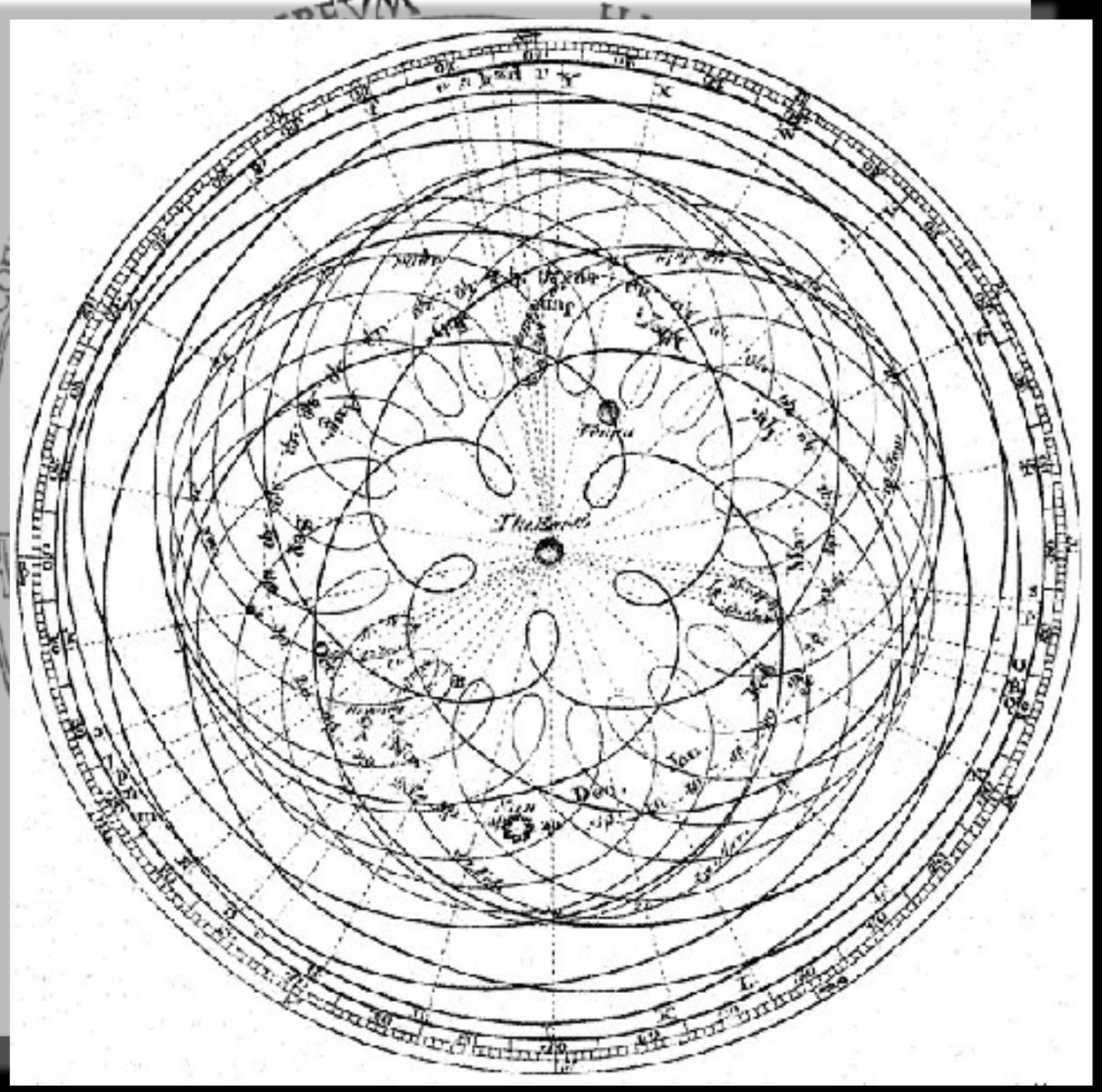
"Complexity needs not to be postulated without a need for it"
"Between 2 theories choose the simpler one"



http://en.wikipedia.org/wiki/File:Ptolemaicsystem-small.png

Peter Apian, *Cosmographia*, Antwerp, 1524
from Edward Grant, "Celestial Orbs in the Latin Middle Ages", *Isis*, Vol. 78, No. 2. (Jun., 1987).

Geocentric models are natural:
from our perspective we see the Sun moving, while we stay still



Source Encyclopaedia Brittanica 1st Edition
Author Dr Long's copy of Cassini, 1777

As observations
improve
this model cannot fit
the data anymore!
not *easily* anyways...

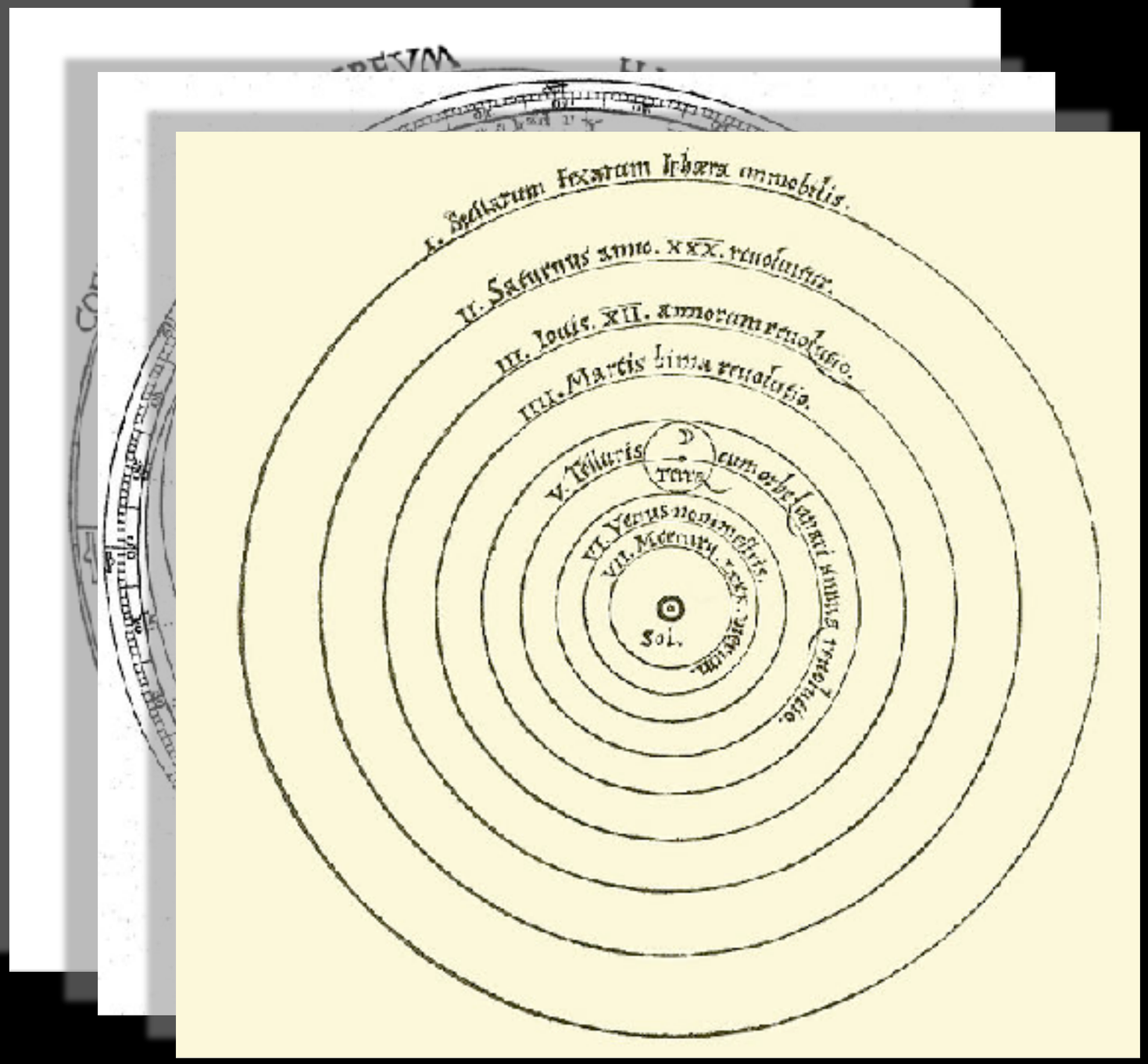


Image of heliocentric model from Nicolaus Copernicus' "De revolutionibus orbium coelestium".

A new model that is much simpler fit the data just as well (perhaps though only until better data comes...)

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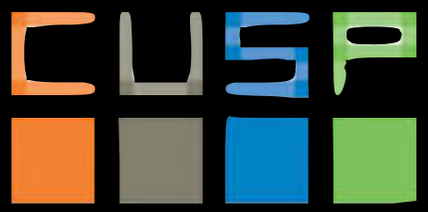

Ockham's razor: ***Pluralitas non est ponenda sine neccesitate***
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William of Ockham (logician and Franciscan friar) 1300ca
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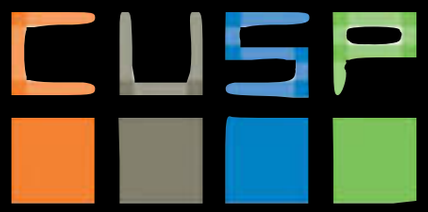
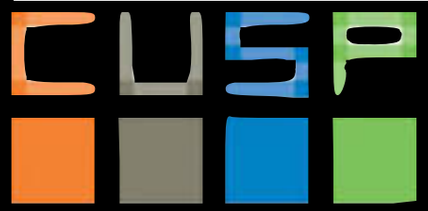
"Complexity needs not to be postulated without a need for it"
"Between 2 theories choose the one with fewer parameters!"



What is the question?

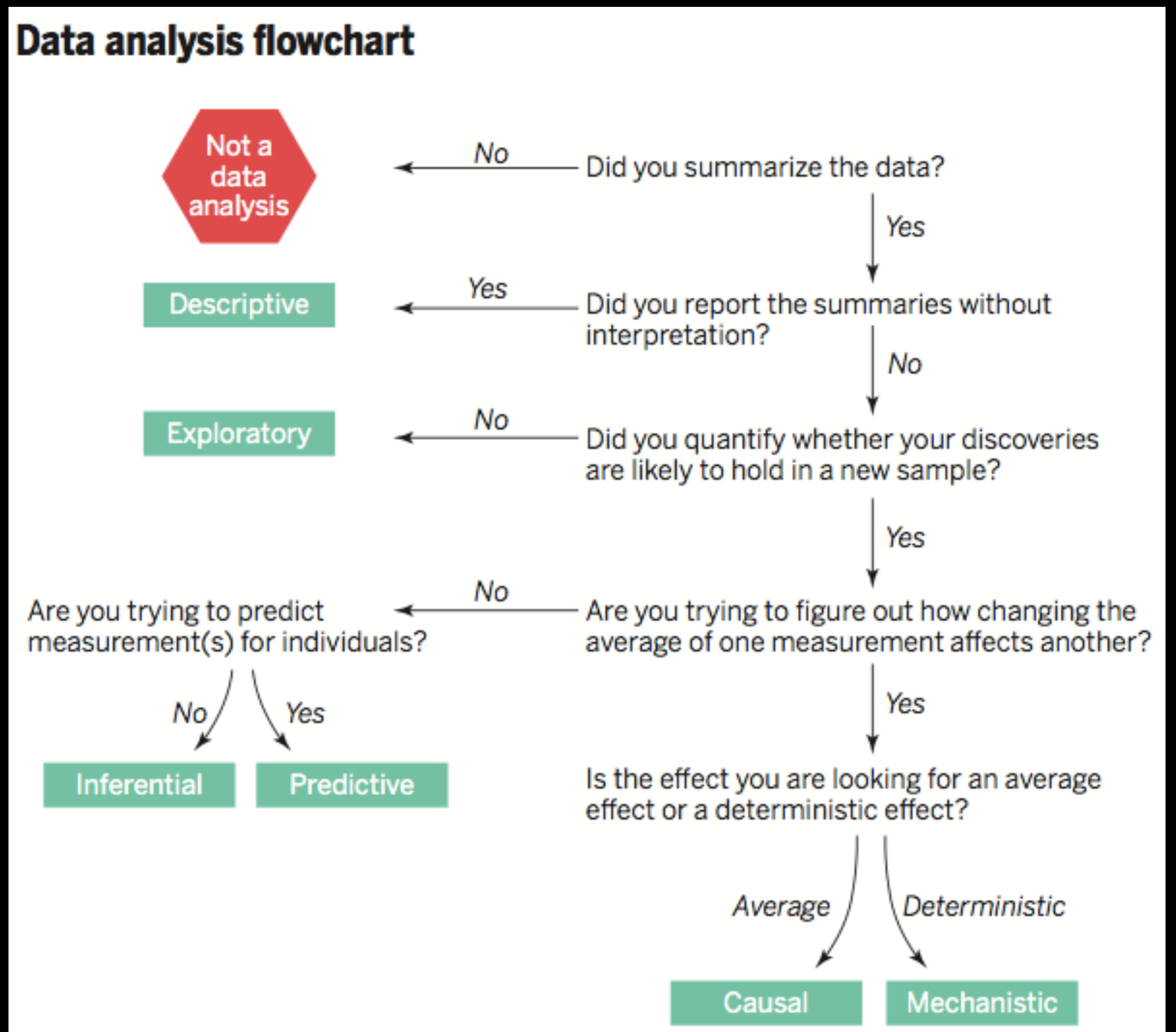
the data speaks, if you know how to listen…

Leek&Rodgers 2015 in *Science*
http://www.sciencemag.org/content/347/6228/1314.full.pdf
http://moscow.sci-hub.bz/4d3cf57483ccf211f66cad18440023cd/10.1126%40science.aaa6146.pdf

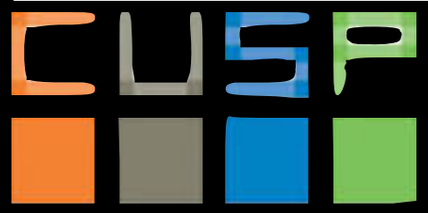


I: Good scientific practice & work flow

What is the question?



Leek&Rodgers 2015 in *Science*
http://www.sciencemag.org/content/347/6228/1314.full.pdf
http://moscow.sci-hub.bz/4d3cf57483ccf211f66cad18440023cd/10.1126%40science.aaa6146.pdf

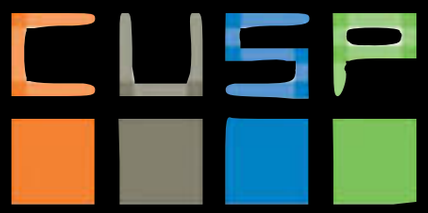


I: Good scientific practice & work flow

The practical side of things

I: Good scientific practice
& work flow

workflow: your environment

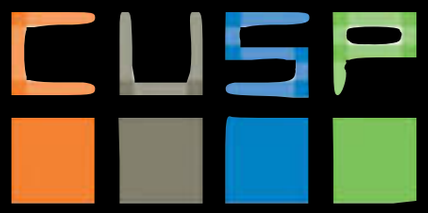


I: Good scientific practice
& work flow

getting to Code:
Python, iPython, iPython notebooks

You should be fluent in *at least Python or R*
to be competitive on the job market

In this class we will only work in Python.
All homework should be developed in
python and delivered through github.



getting to Code:
Python, iPython, iPython notebooks

Python 2.7 vs Python 3.0

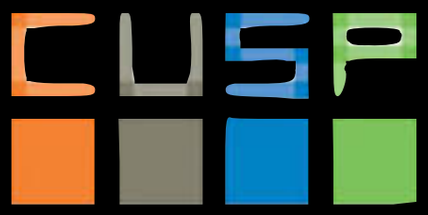
I will write in Python2.7 for compatibility (e.g. GeoPandas)

I will use the future package

```
from __future__ import print_function
__author__ = "Federica B. Bianco, CUSP NYU 2016"
```

to make the code forward compatible with Python 3.0

(though some lines of code may be broken in Python 3.0)

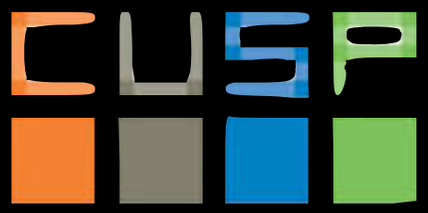


CUSP ADRF with relevant urban data and VEs containing the appropriate setup

http://cusp.adrf.cloud/documentation

I: Good scientific practice
& work flow

reproducible research



I: Good scientific practice
& work flow

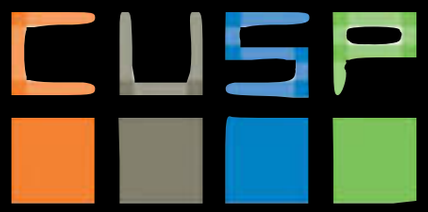
Reproducible research means:

all numbers in a data analysis can be recalculated exactly (down to stochastic variables!) using the **code** and **raw data** provided by the analyst.

Claerbout, J. 1990,
Active Documents and Reproducible Results, Stanford Exploration Project Report, *67*, 139

Reproducible research means:

code **raw data**



I: Good scientific practice
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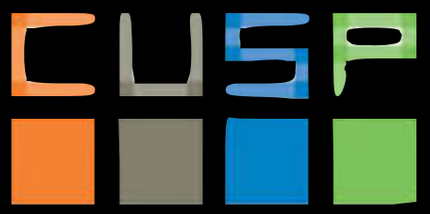
Reproducible research means:

code **raw data**

https://github.com/



I: Good scientific practice
& work flow

Reproducible research means:

code **raw data**

https://github.com/

distributed version control system:

a version of the files on your local computer is made also available at a central server.
The history of the files is saved remotely so that any version (that was checked in) is retrievable.
Others can access and generate their versions of the files enabling collaborative work.

CUSP

Reproducible research means:

code **raw data**

other version control systems:
RCS

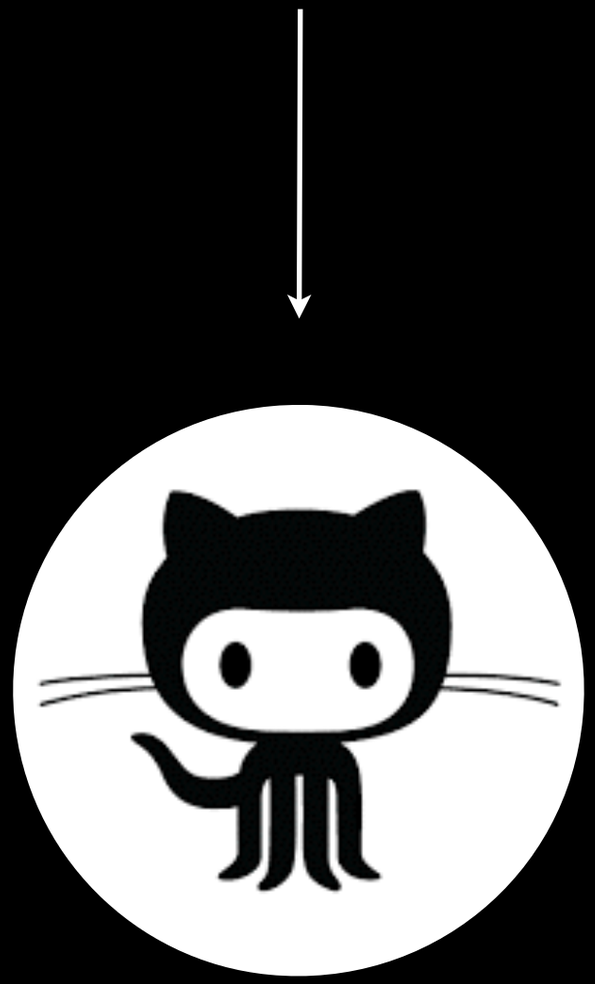
CVS (Centralized version control system)
Subversion
SVN

Git (https://github.com)
Mercurial (https://bitbucket.org/)

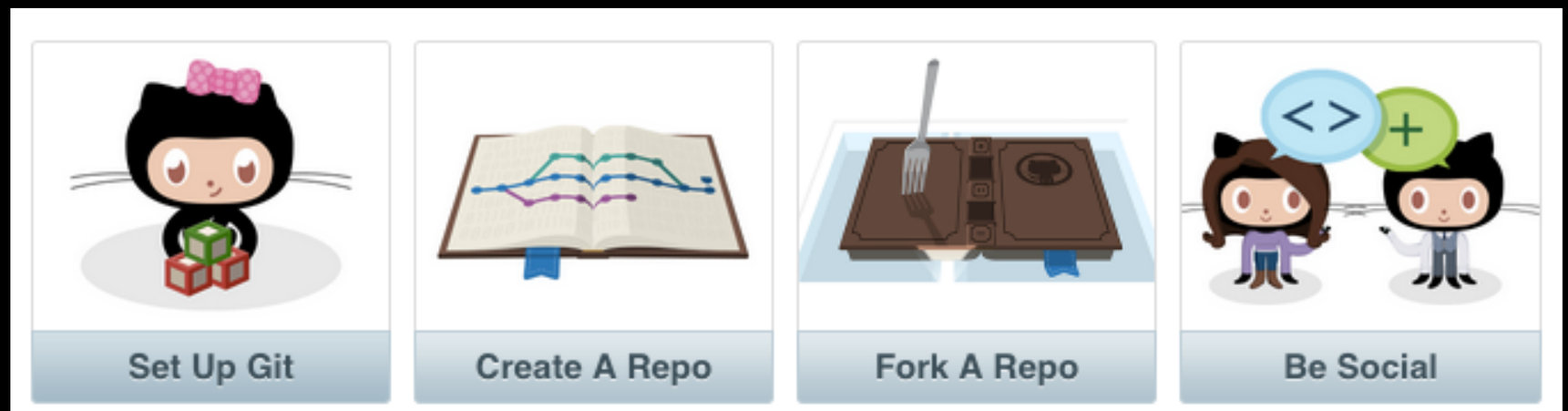
https://git-scm.com/book/en/v2/Getting-Started-About-Version-Control

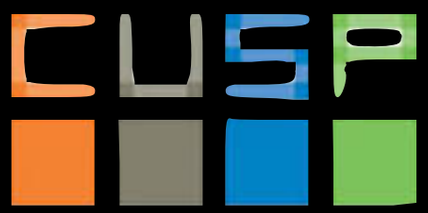
Reproducible research means:

code **raw data**



https://github.com/

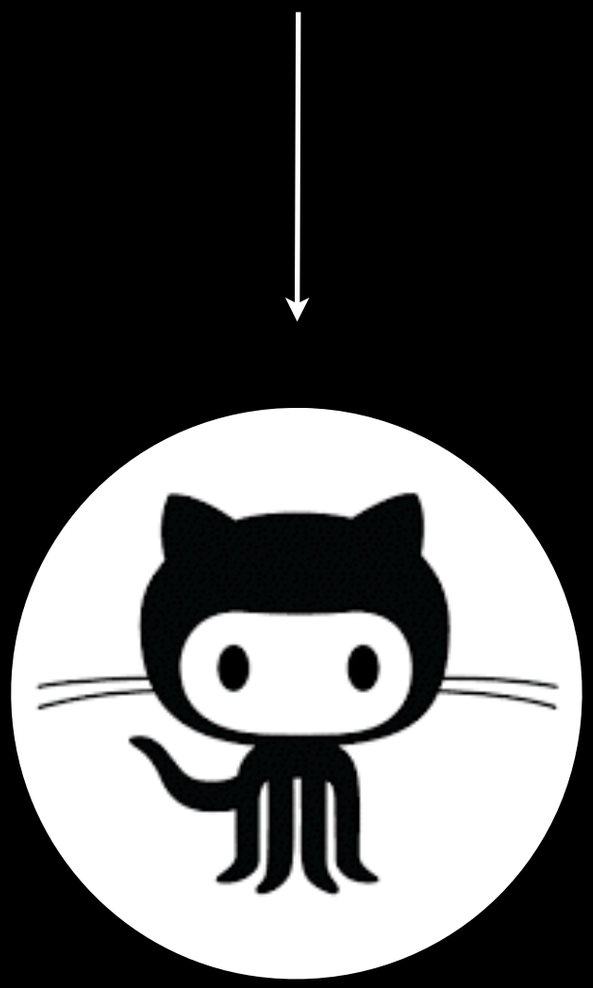




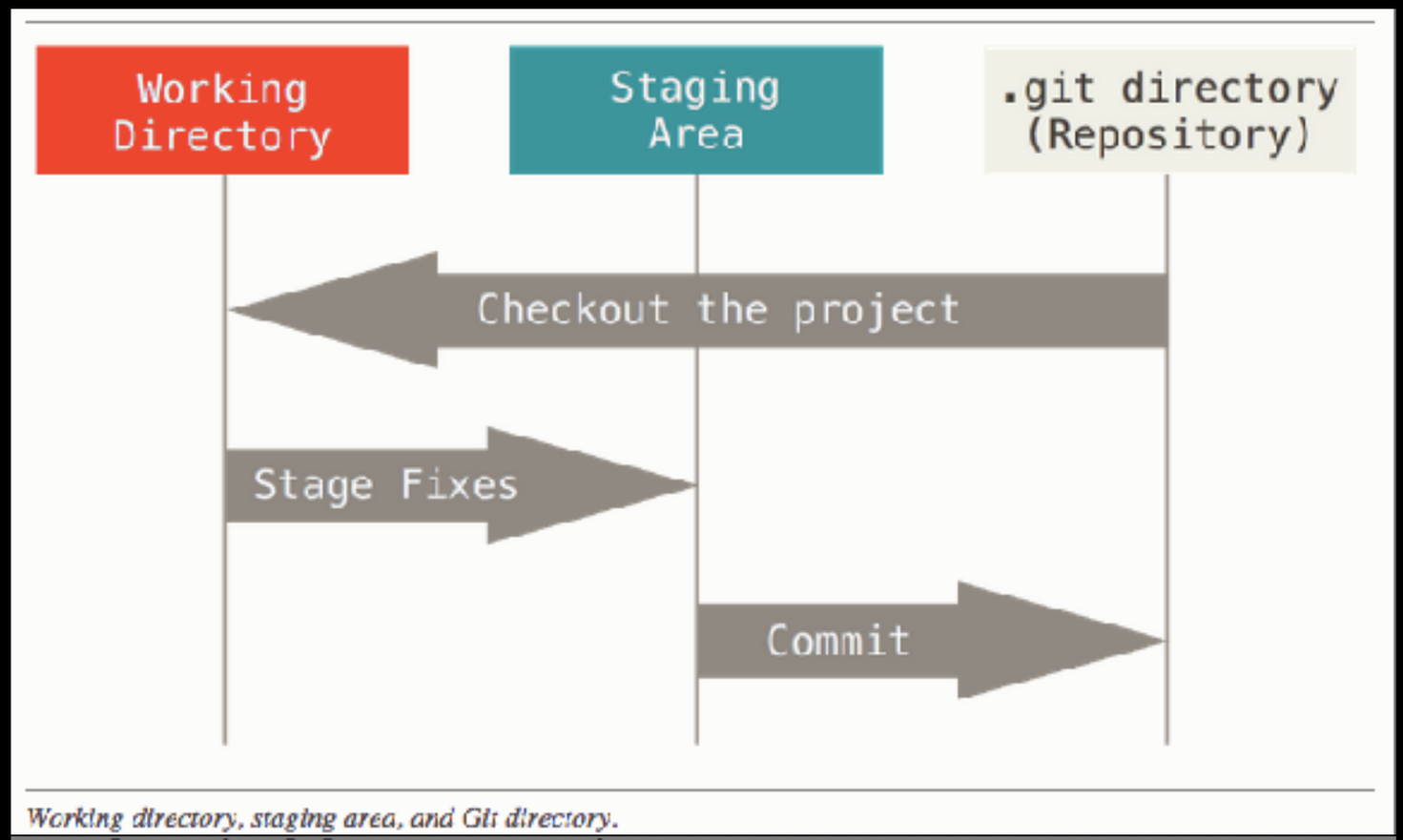
I: Good scientific practice & work flow

Reproducible research means:

code raw data



https://github.com/



Working directory, staging area, and Git directory.

Reproducible research means:

code **raw data**

https://github.com/

markdowns & standards:

in order for your research to be reproducible it has to be understandable:

- Paper or slides
- Repository Markdown files
- Understandable (PEP8 compliant) code - explicit declare the version of the code!

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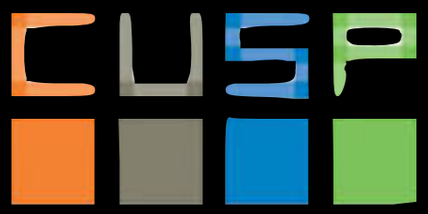
Reproducible research means:

code **raw data**

https://github.com/

markdowns & standards:



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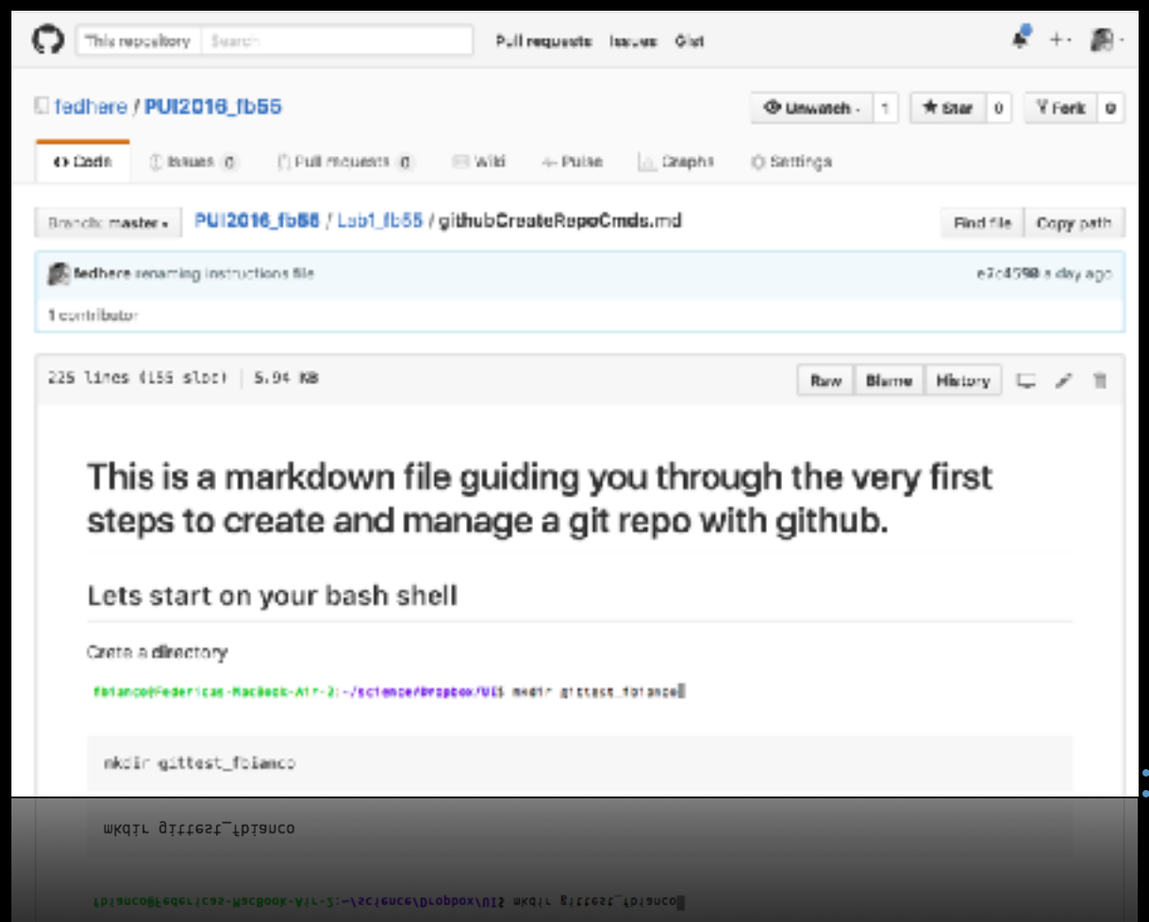
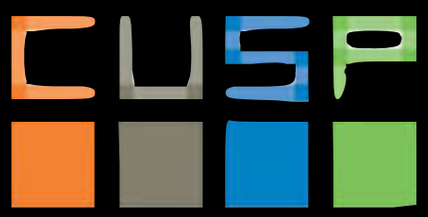


https://github.com/fedhere/PUI2018_fb55/blob/master/Lab1_fb55/githubCreateRepoCmds.md



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Reproducible research means:

code **raw data**

https://github.com/

markdowns & standards:

PEP8: Python Enhancement Proposals 8

"This document gives coding conventions for the Python code comprising the standard library in the main Python distribution."

Readability counts.

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Reproducible research means:

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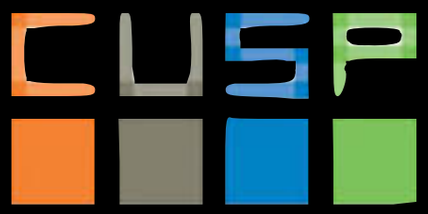
https://github.com/

markdowns & standards:

PEP8: Python Enhancement Proposals 8

Indentation, Tabs or Spaces?, Maximum Line Length, Blank Lines, Source File Encoding, Imports, Whitespace in Expressions and Statements, Comments Bookeeping, Naming



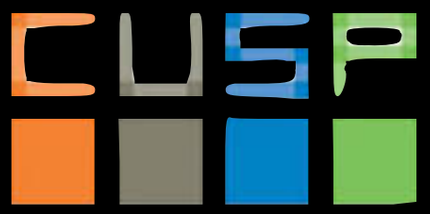
Reproducible research means:

code **raw data**

https://github.com/

a good video tutorial

https://www.youtube.com/watch?v=ZDR433b0HJY



Reproducible research means:

code **raw data**

https://github.com/

let's make a repo!

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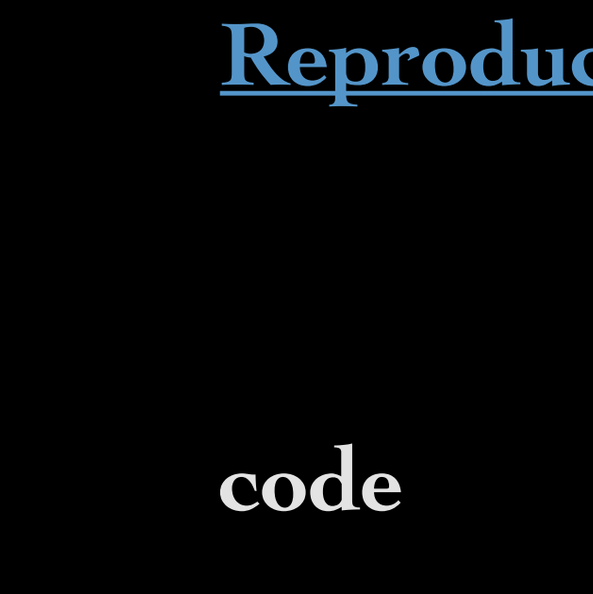
Reproducible research means:

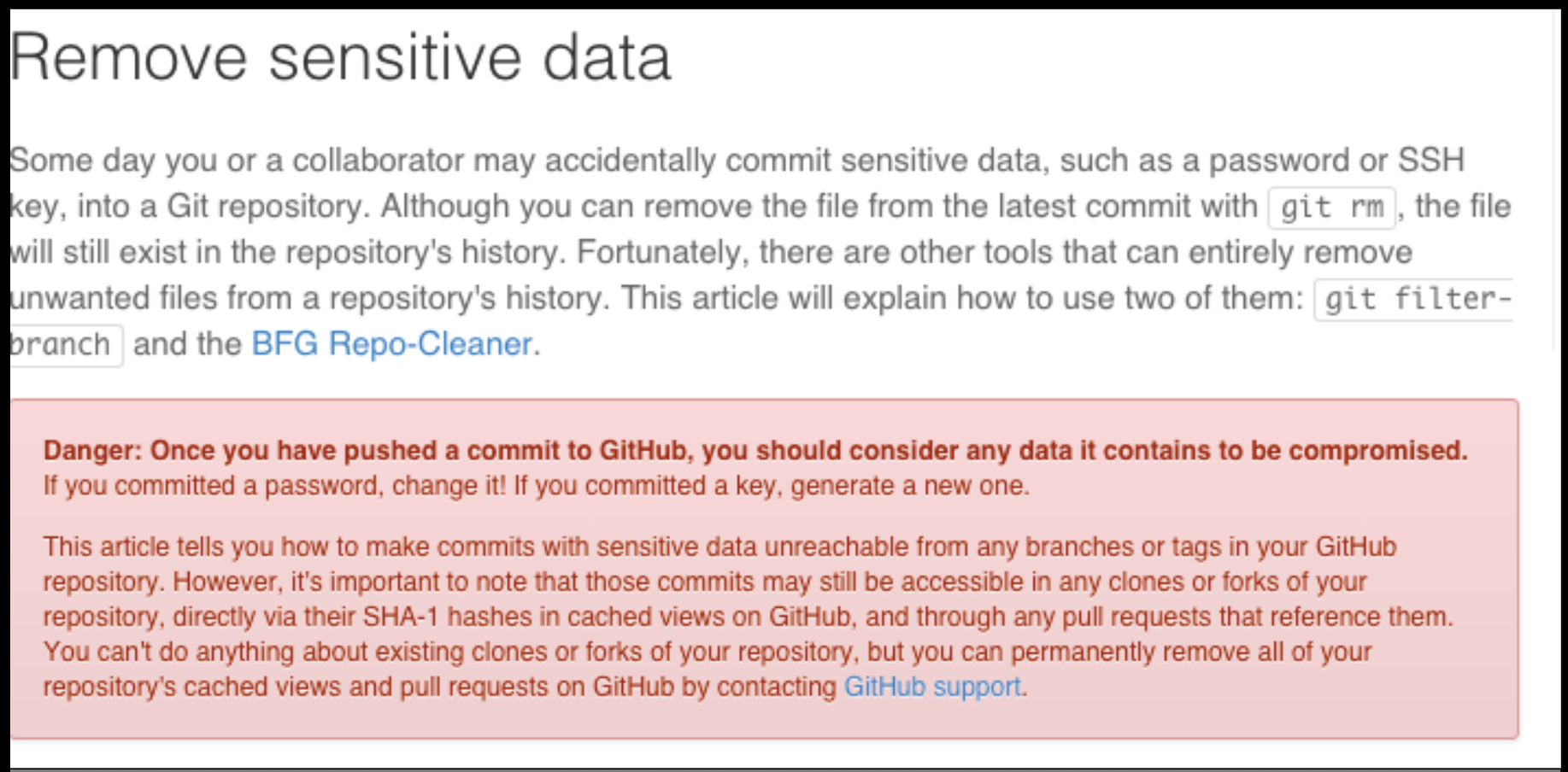
code **raw data**

privacy concerns
in order for your research to be reproducible
the data you use must be accessible BUT
THAT IS NOT ALWAYS POSSIBLE:
CUSP has access to data that has restricted access. **Share your data when possible!**

Reproducible research means:

code **raw data**





Remove sensitive data

Some day you or a collaborator may accidentally commit sensitive data, such as a password or SSH key, into a Git repository. Although you can remove the file from the latest commit with `git rm`, the file will still exist in the repository's history. Fortunately, there are other tools that can entirely remove unwanted files from a repository's history. This article will explain how to use two of them: `git filter-branch` and the BFG Repo-Cleaner.

Danger: Once you have pushed a commit to GitHub, you should consider any data it contains to be compromised. If you committed a password, change it! If you committed a key, generate a new one.

This article tells you how to make commits with sensitive data unreachable from any branches or tags in your GitHub repository. However, it's important to note that those commits may still be accessible in any clones or forks of your repository, directly via their SHA-1 hashes in cached views on GitHub, and through any pull requests that reference them. You can't do anything about existing clones or forks of your repository, but you can permanently remove all of your repository's cached views and pull requests on GitHub by contacting GitHub support.

https://help.github.com/articles/remove-sensitive-data/

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Reproducible research:

How to share your dataaw data

- Share/Reference the source of your **raw** data

- Share the "tidy" data

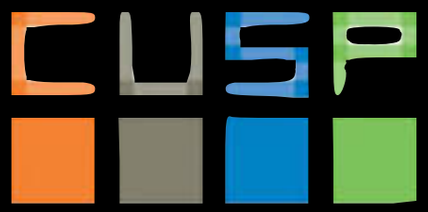
- Share the code used to process the data at each step

example time

Key Concepts:

- falsifiability and law of parsimony
- types of scientific questions
- reproducible research
- PEP8 and style standards

- work with github
- understand how to set up your environment
- basic bash commands
- creating and checking into github an ipython notebook



Resources:

Karl Popper, J. 1934,
The Logic of Scientific Discovery
http://strangebeautiful.com/other-texts/popper-logic-scientific-discovery.pdf

Jeff Leek & Rodger Peng. 2015,
What is the Question? **ASSIGNED READING**
http://www.sciencemag.org/content/347/6228/1314.summary

moscow.sci-hub.bz/4d3cf57483ccf211f66cad18440023cd/10.1126@science.aaa6146.pdf

Claerbout, J. 1990,
Active Documents and Reproducible Results,
Stanford Exploration Project Report, 67, 139
http://sepwww.stanford.edu/data/media/public/docs/sep67/jon2/paper_html/

Jeff Leek, 2015
The Elements of Data Analytic Style

https://leanpub.com/datastyle ($10.00) and https://github.com/jtleek/datasharing

Guido van Rossum, Barry Warsaw, Nick Coghlan, 2001
Proposal Enhancement for Python
https://www.python.org/dev/peps/pep-0008/