Urban Informatics

Fall 2015

dr. federica bianco fb55@nyu.edu

 @fedhere 

CUSP

Urban Informatics

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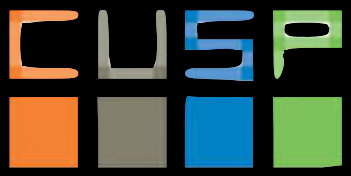
office hours: Mon/Thu 2-4



Urban Informatics

Dr. federica bianco fb55@nyu.edu,
astrophysicist

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

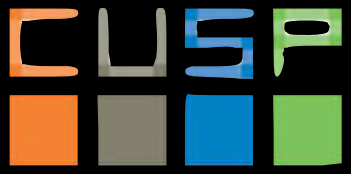
CUSP


CUSP
Urban Observatory

Urban Informatics

Class website:

http://cosmo.nyu.edu/~fb55/PUI2016

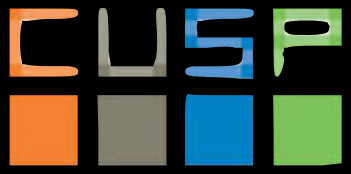


Urban Informatics

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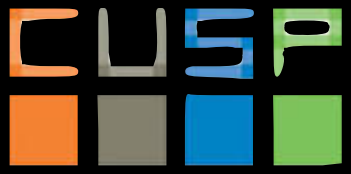
from beginning of class to 5 minutes past the hour (be on time!)
questions on previous class material AND READING ASSIGNMENTS



Urban Informatics

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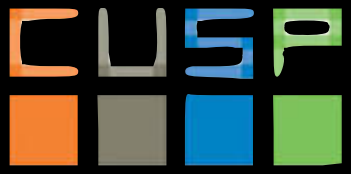
- 10 % class performance and participation
  - ask questions
  - answer questions
  - get up and code
  - extra credit assignments
- 25 % homework
- 25 % midterm
- 35 % final



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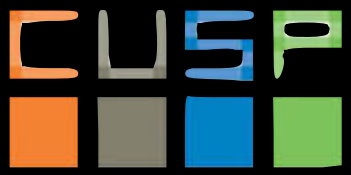

Homework projects must be turned in as iPython notebooks by checking them into your github account in the PUI2016_<netID> repo and the project directories HW<hw number>_<netID> (unless otherwise stated). <nyuid> is e.g. fb55

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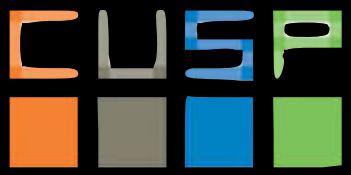

we encourage you to work in groups! but as a collaborative project where different group members lead different aspects of the work. A statement to describing your contribution to the project MUST be included in the README (a la *Nature Magazine*).

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.

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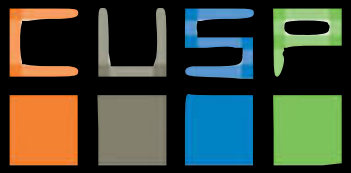
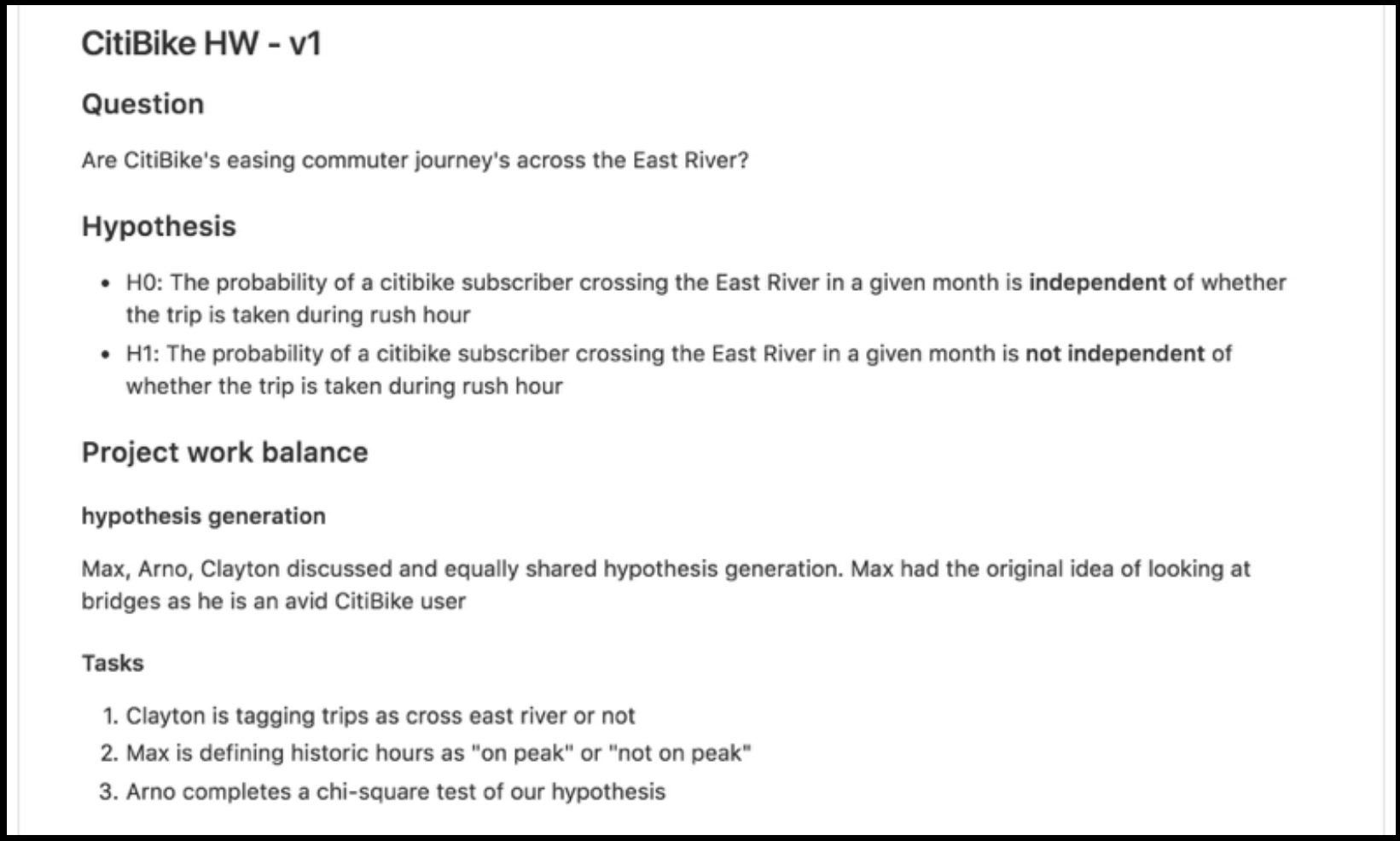


we encourage you to work in groups! but as a collaborative project where different group members lead different aspects of the work. A statement to describing your contribution to the project MUST be included in the README (a la *Nature Magazine*).

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

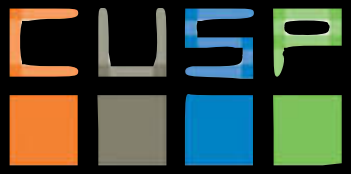
Project work balance

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



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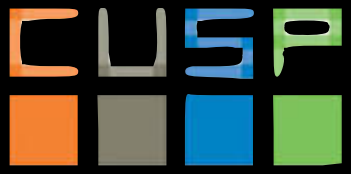
After the midterm projects will be code reviewed by your peers.
We'll have 1 multi-week homework project from proposal to peer review.
https://blog.fogcreek.com/increase-defect-detection-with-our-code-review-checklist-example/



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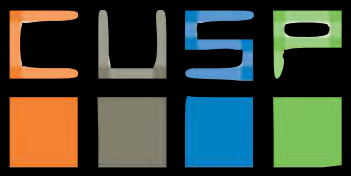
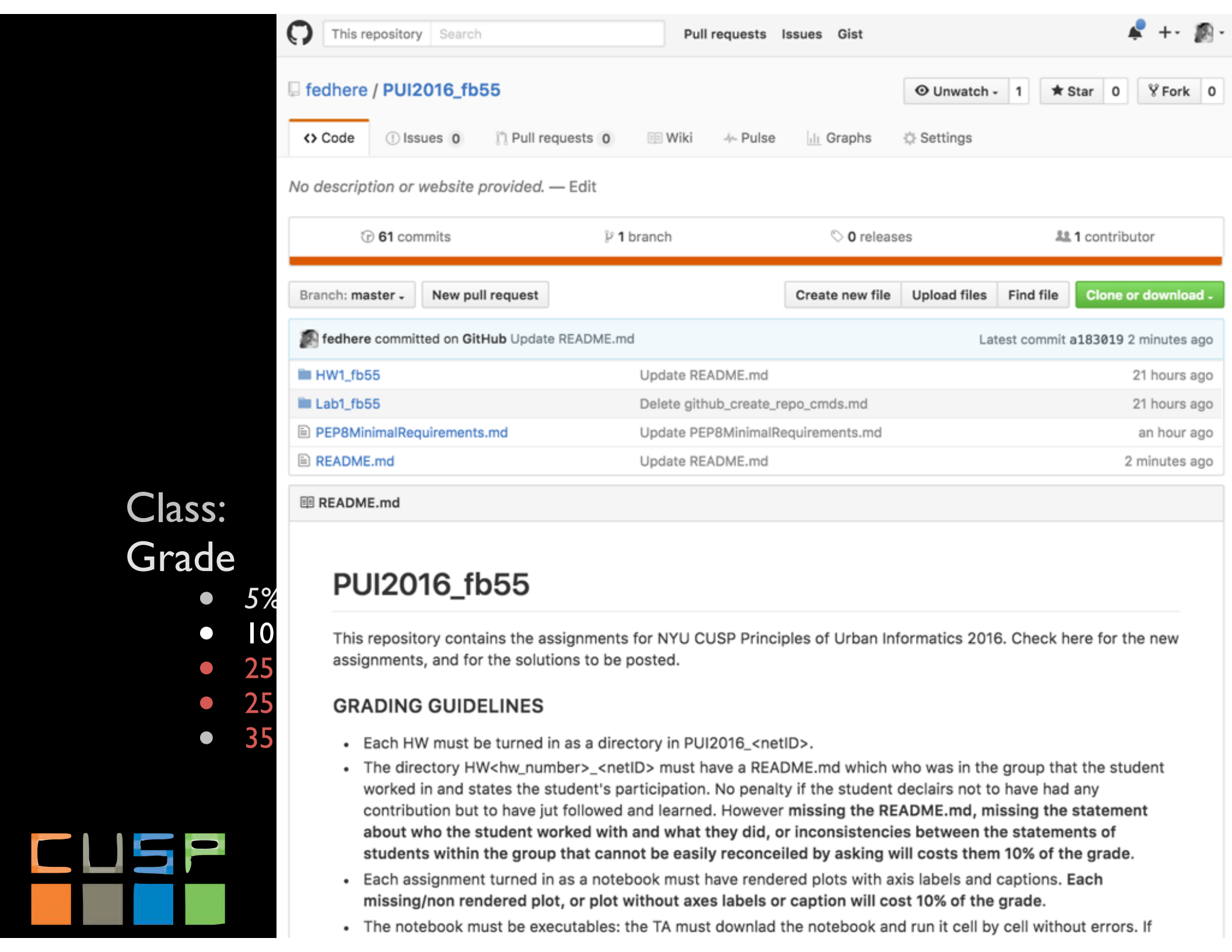
Midterm and Final will include aspects of the work developed in the homework sessions. Failing to actively participate in the homework will result in not being able to get the Midterm and Final done.





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- 5%
- 10
- 25
- 25
- 35

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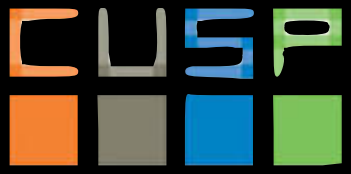
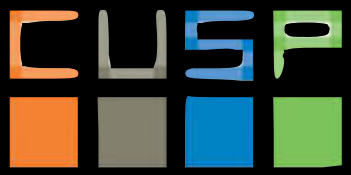
Urban Informatics

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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  - validation (simulations)
- interpretation
- presentation
  - visualization
  - write a paper or give a talk

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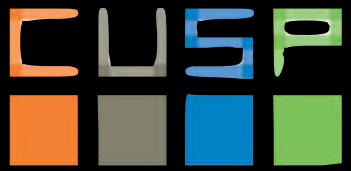
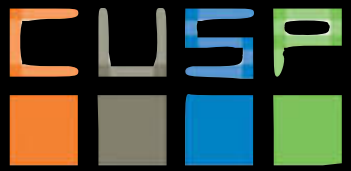
The phylosofical side of things



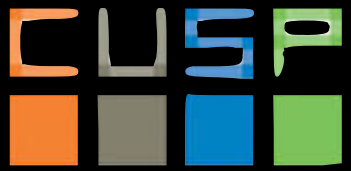
what is a scientific theory?



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"

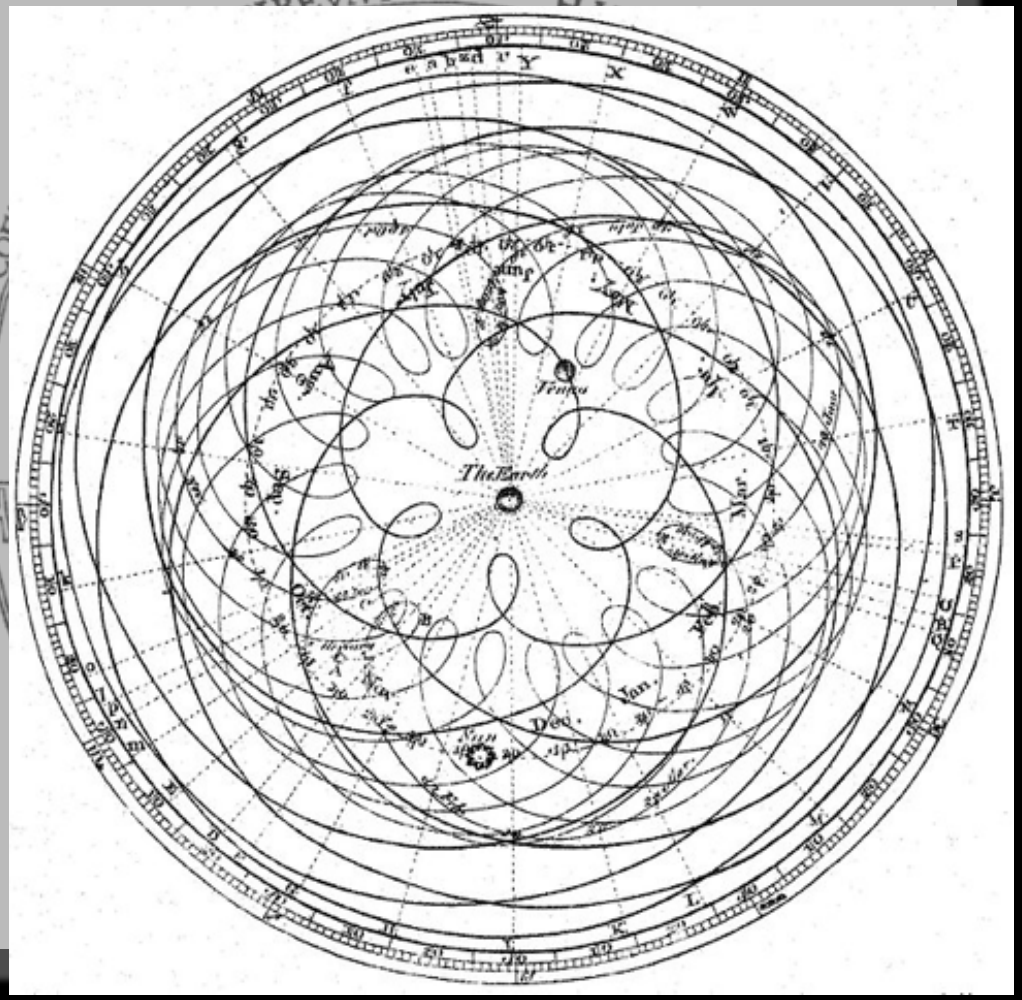
the earth is round, and it orbits around the sun

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

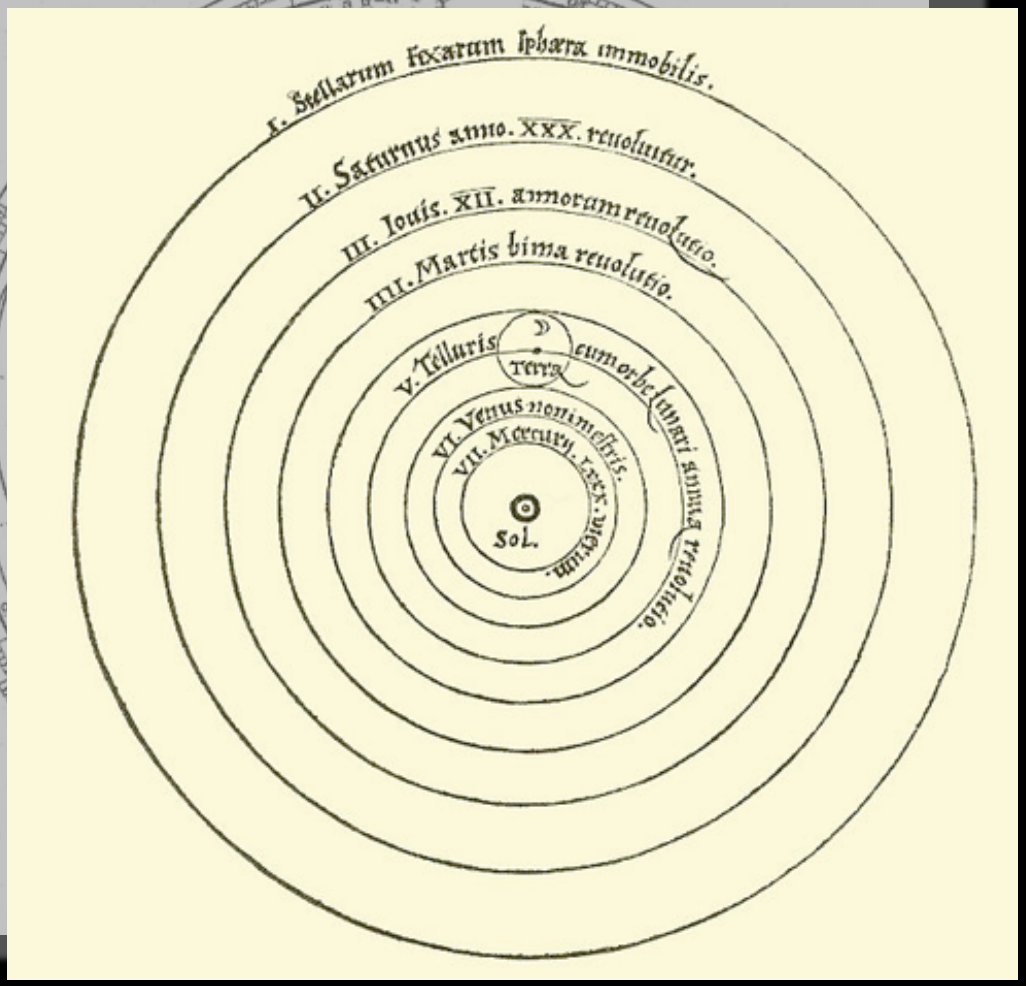
the earth is round, and it orbits around the sun



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...

the earth is round, and it orbits around the sun



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

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

Ockham's razor: *Pluralitas non est ponenda sine neccesitate*

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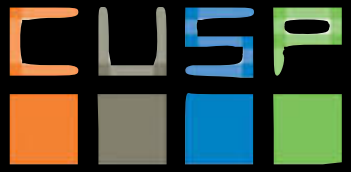
"Complexity needs not to be postulated without a need for it"

"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



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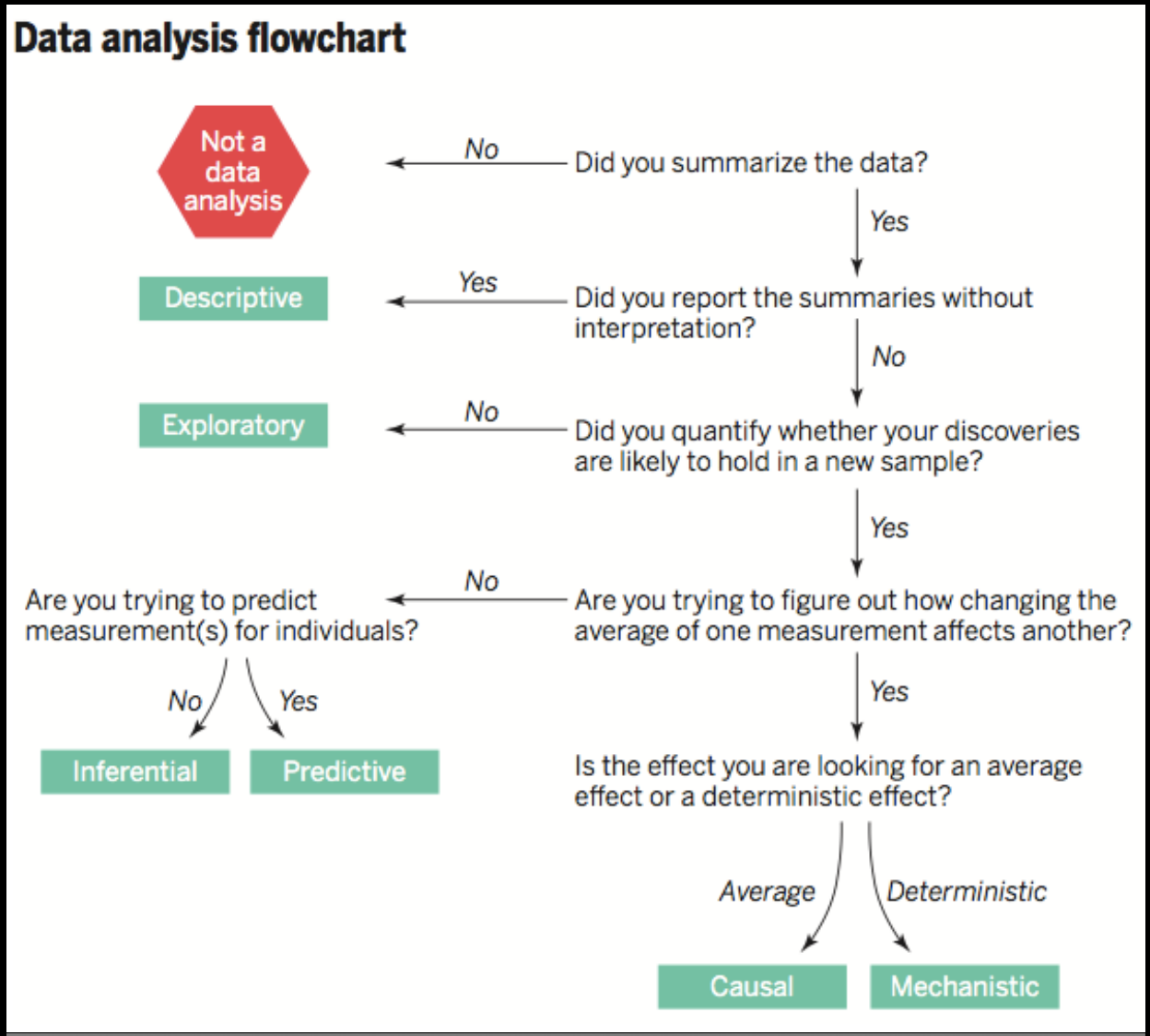
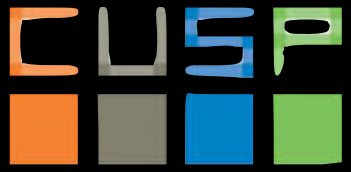
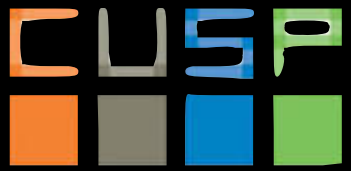


Leek&Rodgers 2015 in *Science*
http://www.sciencemag.org/content/347/6228/1314.full.pdf
http://moscow.sci-hub.bz/4d3cf57483ccf211f66cad18440023cd/10.1126%40science.aaa6146.pdf

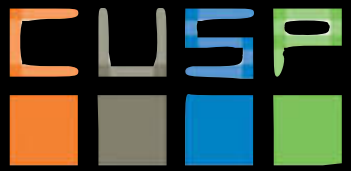


I: Good scientific practice & work flow

The practical side of things



workflow: your environment

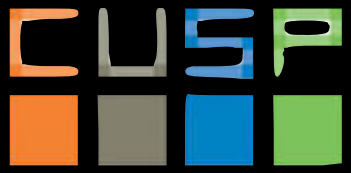


Operating System:

Android, BlackBerry, BSD, Chrome OS, OS X, iOS, QNX, Linux
Steam OS

Microsoft Windows, Windows Phone, and z/OS.

FreeRTOS, Micrium, and VxWorks



I: Good scientific practice & work flow

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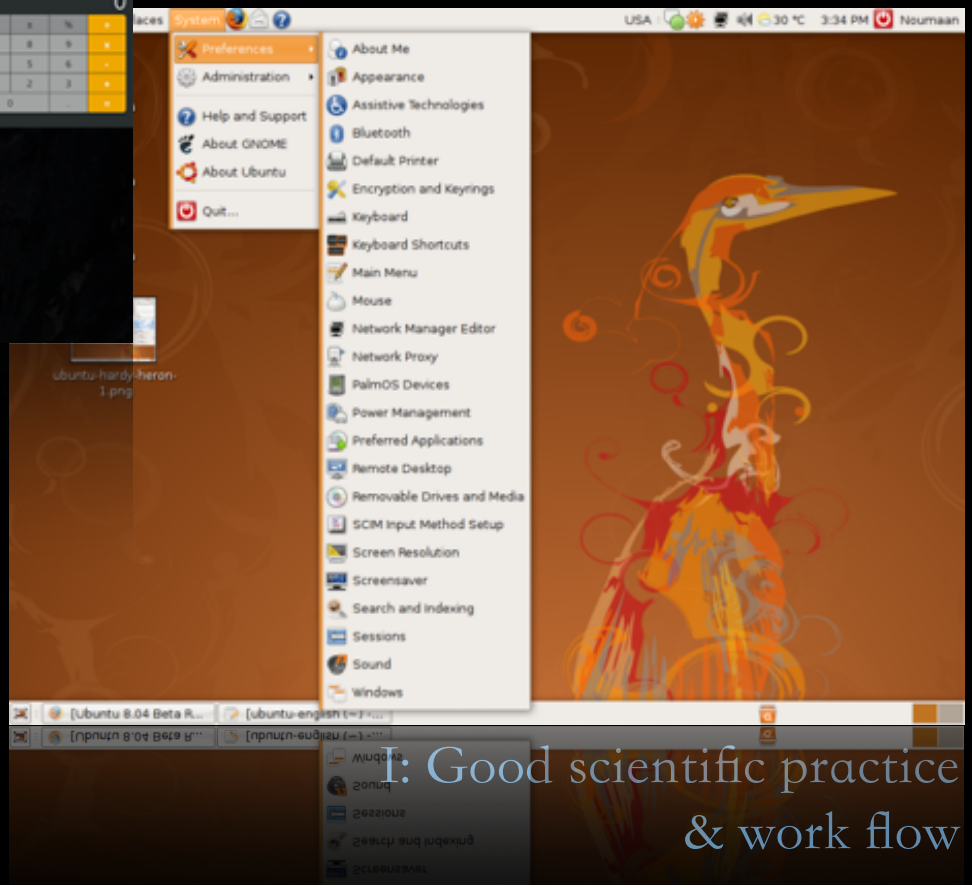

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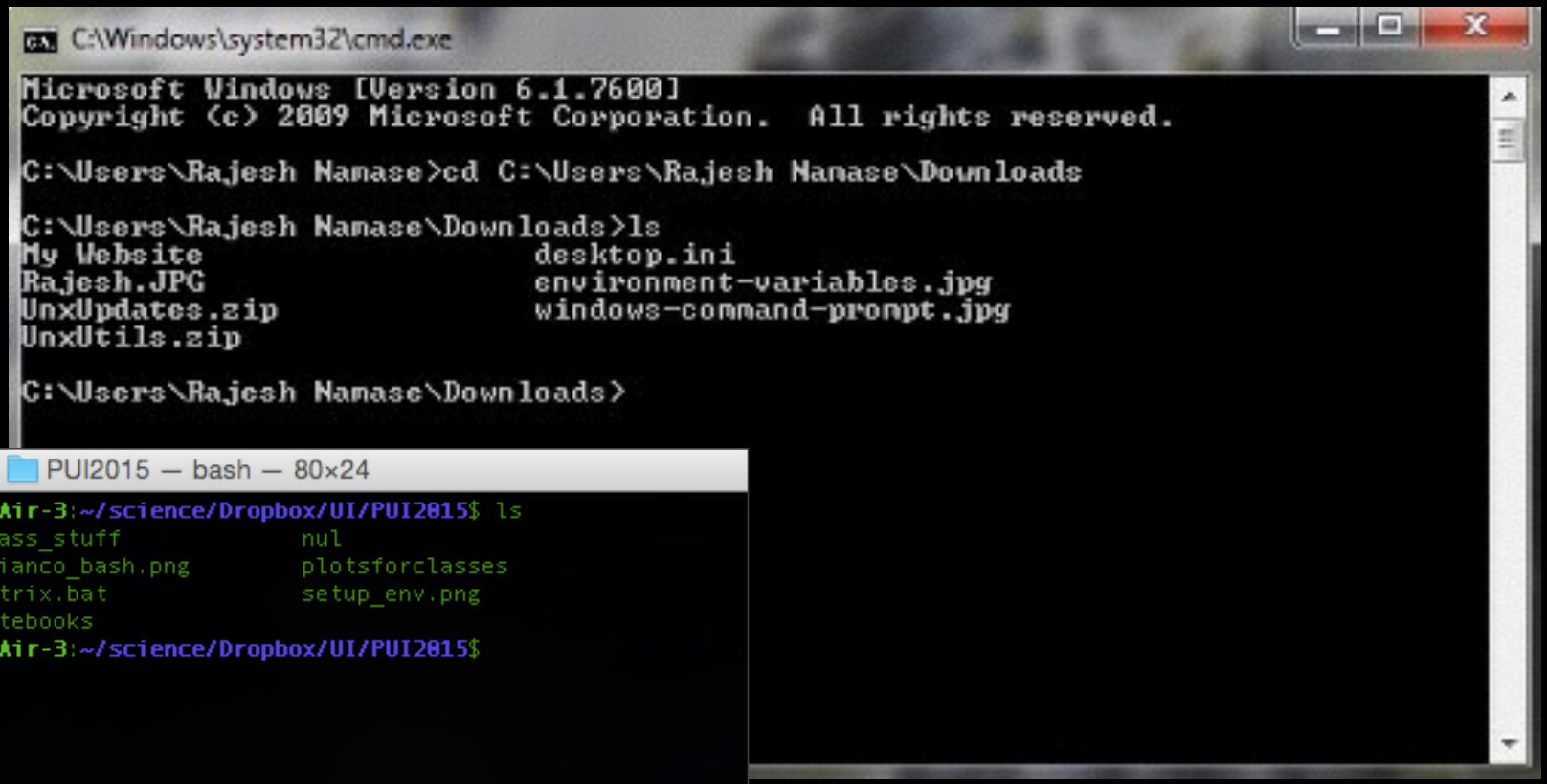
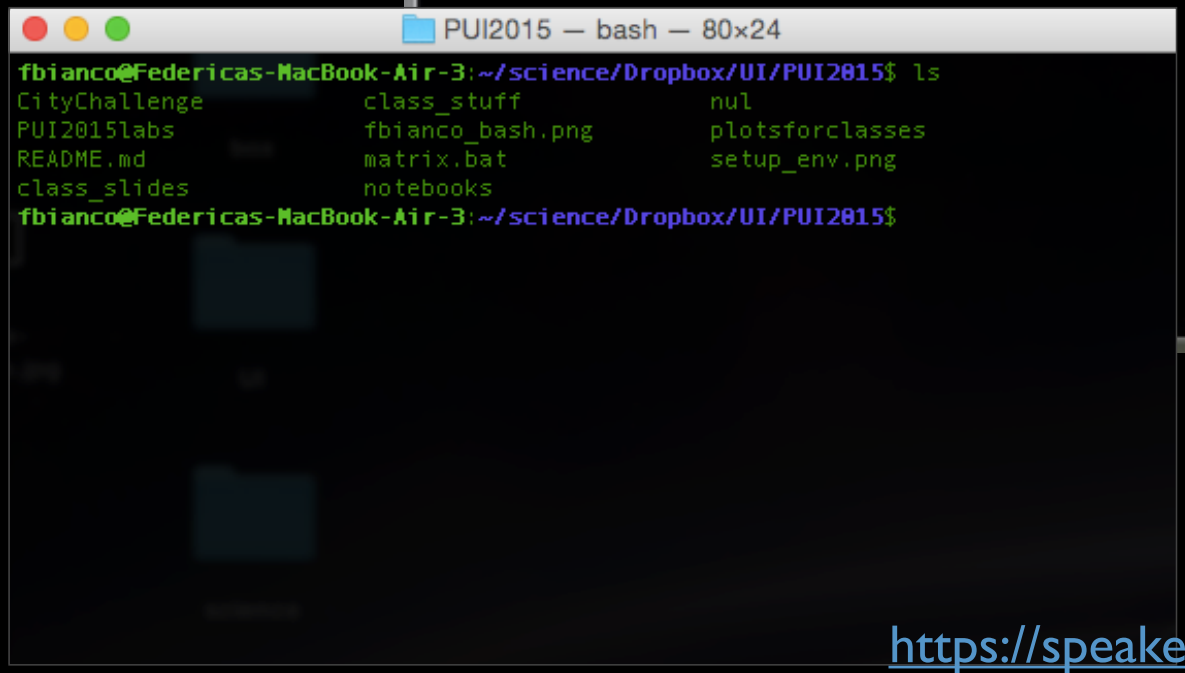
1: Good scientific practice & work flow

Operating System:





https://speakerdeck.com/62gerente/bash-introduction

You have a *bash* shell on Compute (which is Linux)

- **and you have access to compute via ssh**

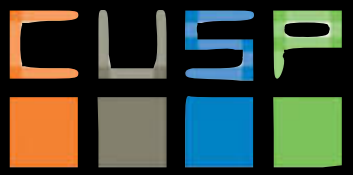
ssh -X -A -t cuspid@gw.cusp.nyu.edu ssh -A -X compute

- **or in the Green Environment of the CUSP data facility via remote desktop**

ssh cuspid@gw.cusp.nyu.edu -L9000:wingrdp.cusp.nyu.edu:3389

followed by remote desktop to localhost:9000

https://datahub.cusp.nyu.edu/computing.html#accessing_the_workspace



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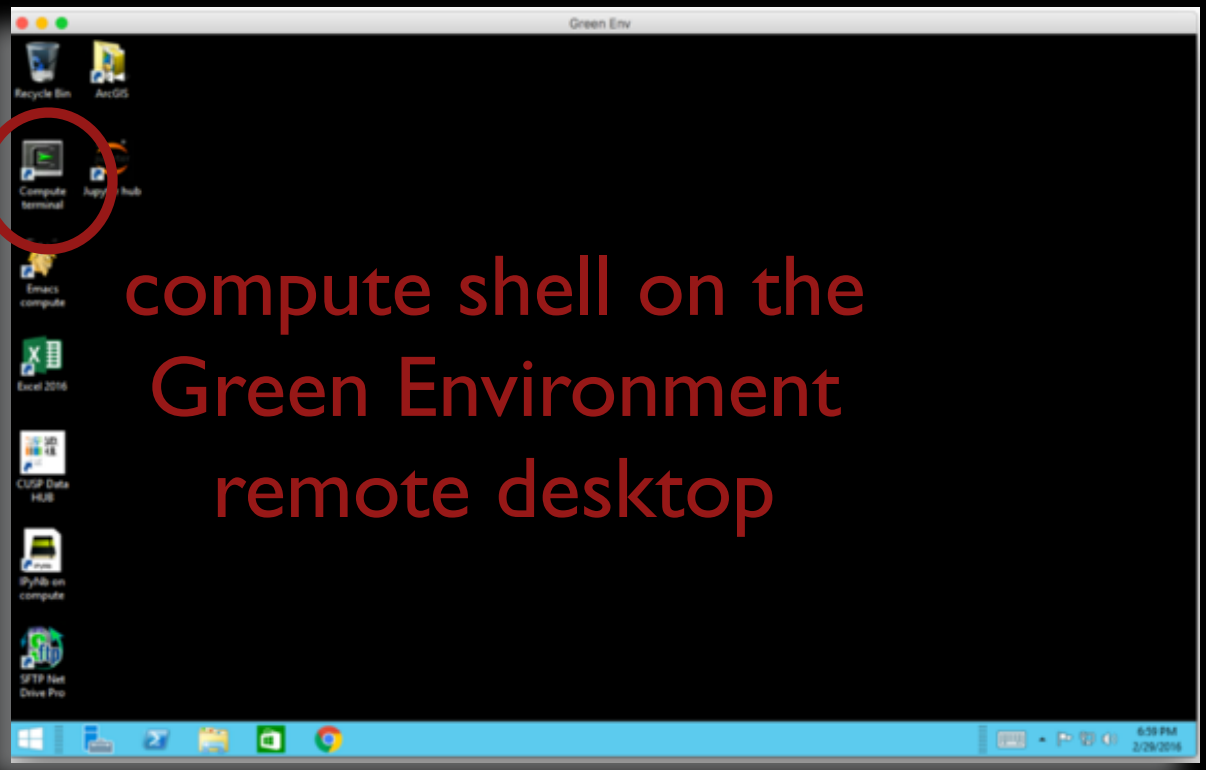


Remote desktop acces in Green environmen

Operating System:

Shell commands & Environmental variables demo

https://speakerdeck.com/62gerente/bash-introduction

Operating System:

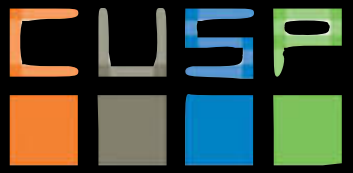
Shell commands & Environmental variables demo

essential commands

pwd
ls
mkdir
cd
touch
cp
mv
rm
less
echo
head/tail
top
ps
bg
chmod
chown
grep

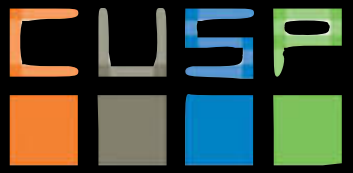
ssh
scp
rsync
df
du

alias
export
Wildcards
I/O Redirection
Standard Output
Standard Input
Pipes
Listing your processes
Killing a process



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

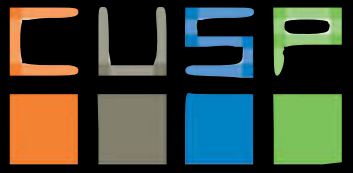
I will write in Python2.7 for compatibility (e.g. GeoPandas)

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)



Choosing a text Editor: Integrated or not?

Emacs: "extensible, customizable, self-documenting real-time display editor"

customizable via the .emacs file

can be run without tunneling with `emacs -nw`

the command sequences are tricky (customize emacs for python https://realpython.com/blog/python/emacs-the-best-python-editor/)

PyCharm, Sublime, Brakets: Integrated Development Environment: checks syntax and standard compliancy

can be run directly within the developing window

recognizes the syntax for other codes (DJango)

integrated with version control

Jupyter Notebooks: Browser-based interactive computational environment

demo time!

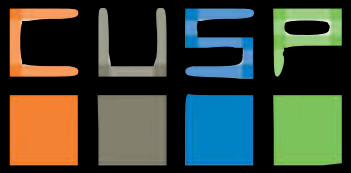
Choosing a text Editor: Integrated or not?

Emacs:

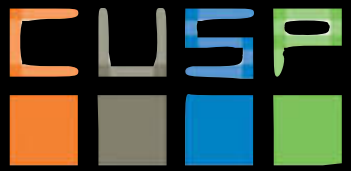
PyCharm:

demo time!

Jupyter Notebooks:



reproducible research



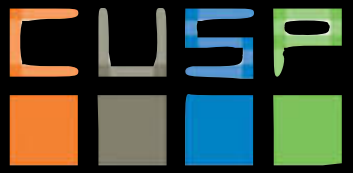
Reproducible research means:

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**



Reproducible research means:

code **raw data**

https://github.com/

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.

Reproducible research means:

code **raw data**

other version control systems:
RCS

CVS (Centralized version control system)
Subversion
SVN

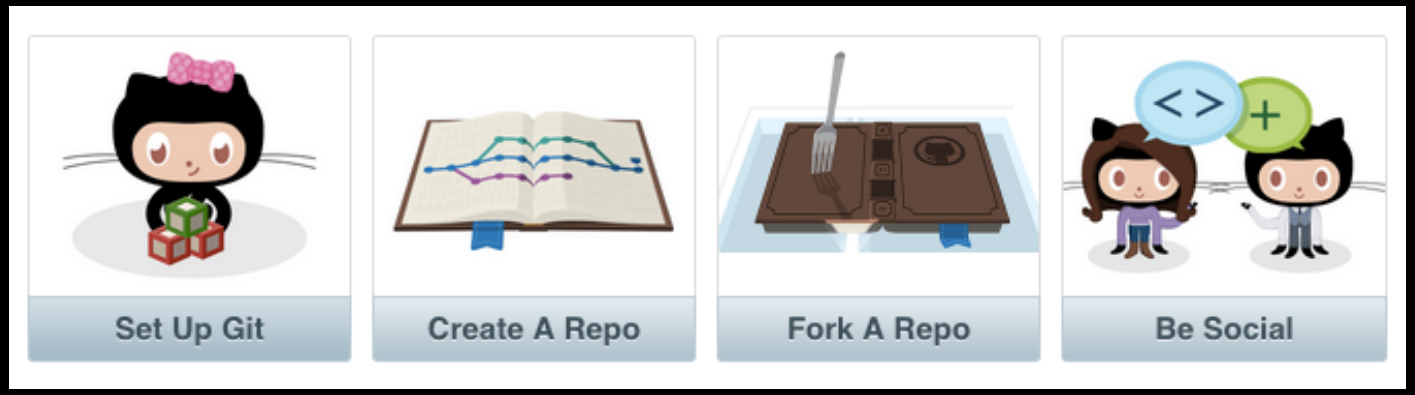
Git (https://github.com)
Mercurial (https://bitbucket.org/)

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

Reproducible research means:

code **raw data**

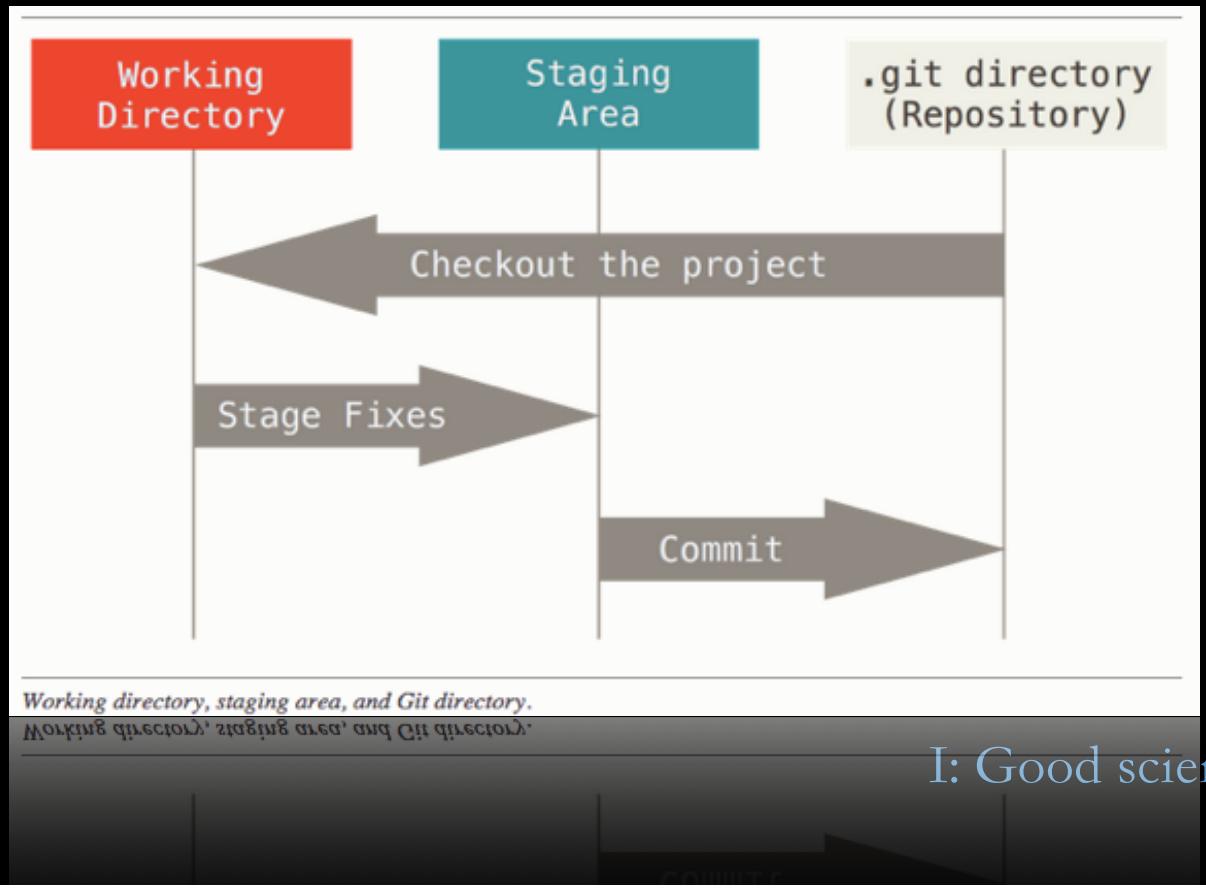
https://github.com/



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!

Reproducible research means:

code **raw data**

https://github.com/

markdowns & standards:

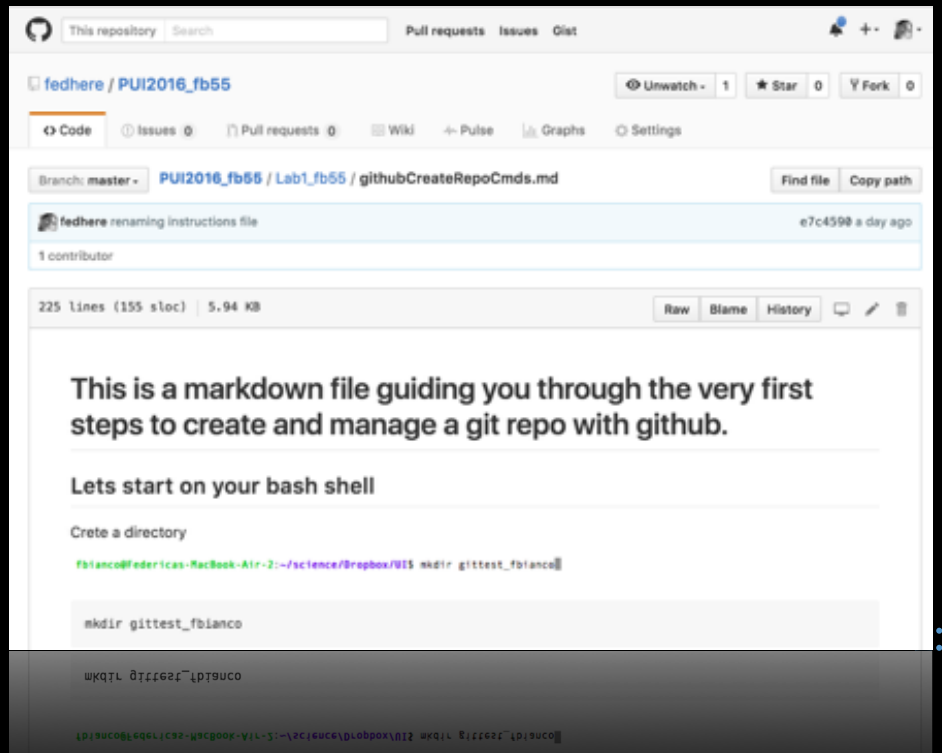
Reproducible research means:

code

raw data

https://github.com/

markdowns & standards:



https://github.com/fedhere/PUI2016_fb55/blob/master/Lab1_fb55/githubCreateRepoCmds.md

: Good scientific practice & work flow

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.

CUSP

Reproducible research means:

code **raw data**

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

CUSP

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!

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/

Reproducible research:

How to share your dataaw data

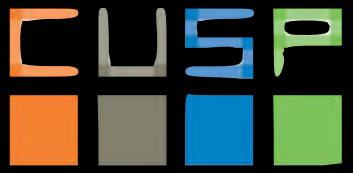
- Share/Reference the source of your **raw** data
- Share the "tidy" data
- Share the code used to process the data at each step

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/