Getting started with R and Python for data analysis

- Tutors and organizers (1st Meeting) :
  - Felix Salim (Yamada Laboratory-Titech)
  - Mia Fitria Utami (Yamada Laboratory-Titech)
  - Pande Putu Erawijantari (Yamada Laboratory-Titech)

Tokyo, November 9th 2019

# Pre-meeting requirements:

1. Install R and R studio (version + link): http://swcarpentry.github.io/r-novice-inflammation/setup.html
2. Install python (suggestions: anaconda for convenience; miniconda if you have diskspace problem): http://swcarpentry.github.io/python-novice-inflammation/setup/
3. Download trial dataset: http://swcarpentry.github.io/r-novice-inflammation/data/r-novice-inflammation-data.zip
4. Your own problem set and/or tools/packages of interest : Optional but very helpful to decide the topic for next meeting

Rundown (flexible)

- Introduction (15 min)

- Q and A (10 min)

- Break (5 min)

- Hands on (45 min): troubleshoot installations; load data; help manual

search

- free discussion (15 min)

Who need to learn data analysis?

- Are you dealing with bunch of numbers from experiment(s)?
- Do you want to know more about "world"?
- Are you curious about some trivial things?

If one of the answer is YES! then you need to do data analysis

Gold rules:

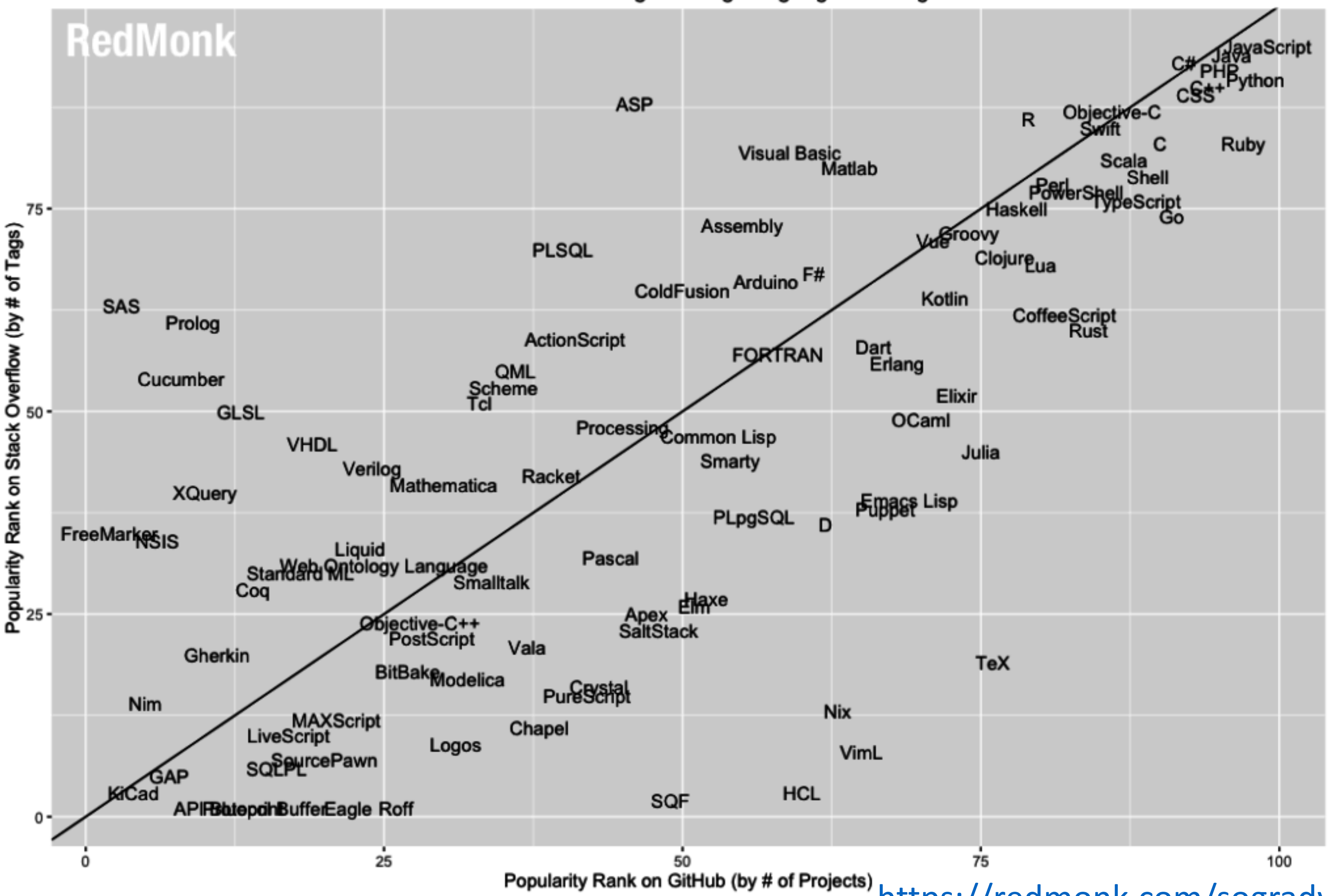
NEVER EVER TRUST YOUR TOOLS (OR DATA). So who to trust?

14% respondents have learned R

50% respondents have learned python

Why choose both?
It’s FREE and POWERFUL !!!

Programing language popularity



RedMonk Q318 Programming Language Rankings

https://redmonk.com/sogrady/2018/08/10/language-rankings-6-18/

Why R?

- Free and open source
- High level language with widespread usage
- Programming language for statistical analysis and data visualization (can do other things, but not intended for them, consider Python instead)
- Loads of packages for many applications (tidyverse, tidymodels, shiny, etc.)
- Easy to do reproducible research and results sharing (Rmarkdown, Shiny, R packages or R projects)

Popular usages

- Statistical analysis: R is mainly used by statisticians and it has lots of support to do statistical analysis, such as statistical distribution, data modelling and data wrangling
- Data visualization: Publication ready plots can be produced straight from R
- Research sharing: R allows us to share data and script between collaborators easily by organizing it as a package or Shiny web application

R is used mostly in academic or research, especially those that relies on statistics (i.e. biology, healthcare, social studies, etc.)

Intro to R studio

+ Friendlier UI compared to basic R
+ Lots of convenient functionality (file explorer, terminal, environment and plot viewer, etc.)
+ Accessible from web browser (Rstudio server)
+ Easy interactive analysis (write and execute)

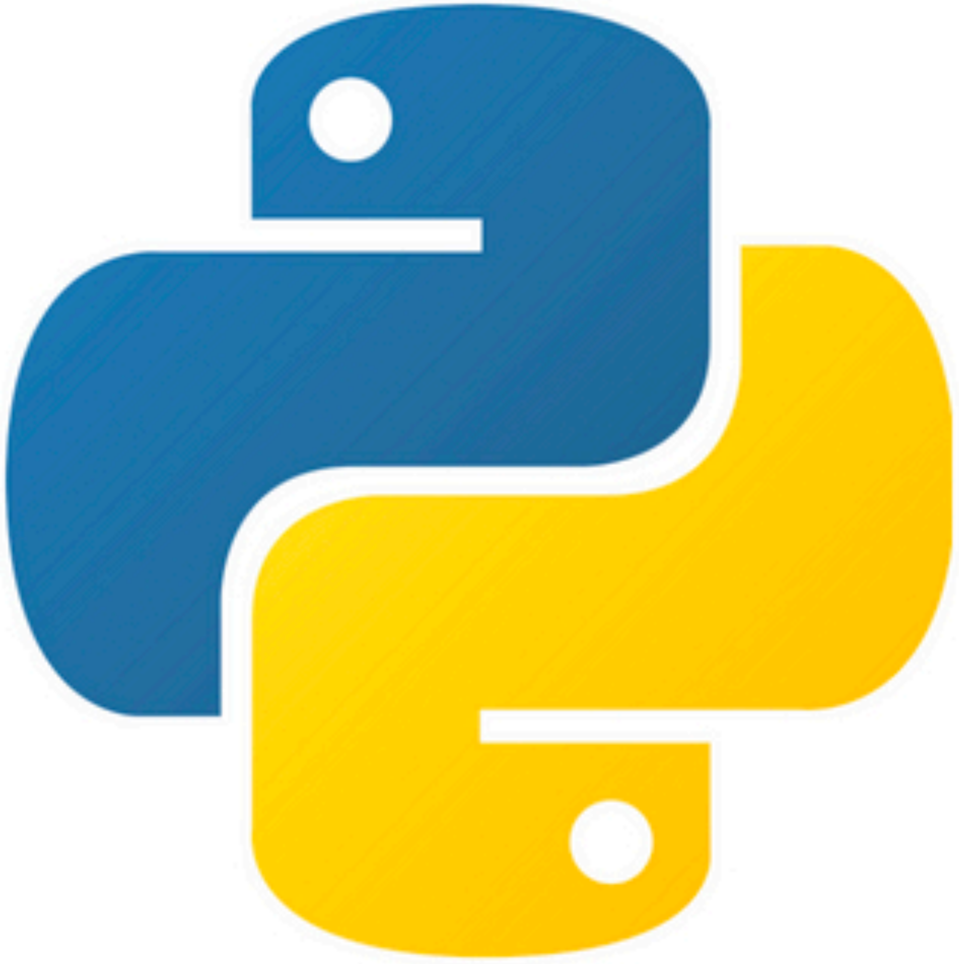
- Harder to share compared to Jupyter notebooks
- May induce spaghetti code writing
- Multithreaded code may not run properly

Favorite packages (Felix-Picks)

tidyverse
www.rstudio.com

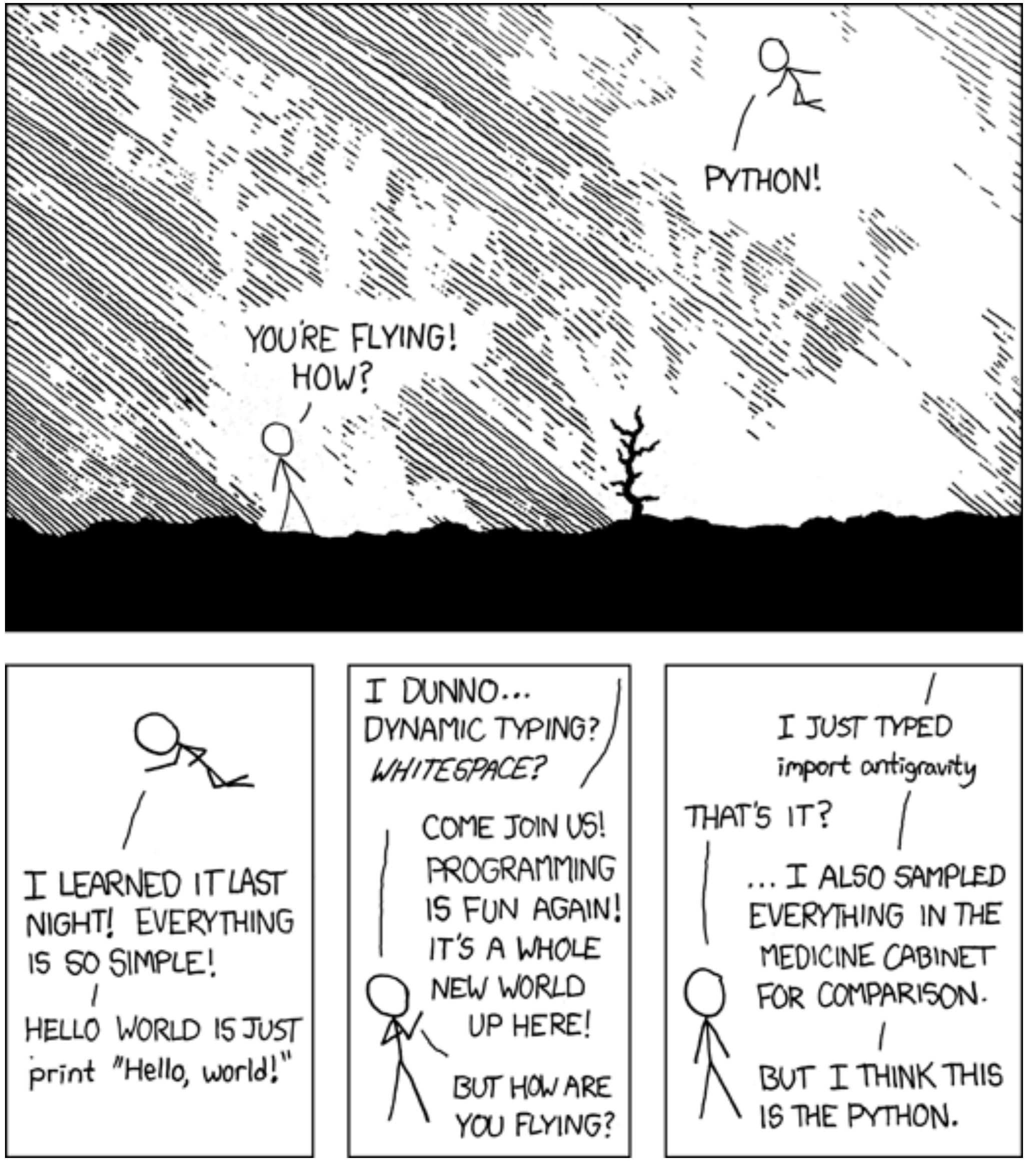
Shiny
www.rstudio.com

R
rmarkdown
www.rstudio.com



My Favorite free source (CC-BY license for uncommercial usage): http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf

Why Python?

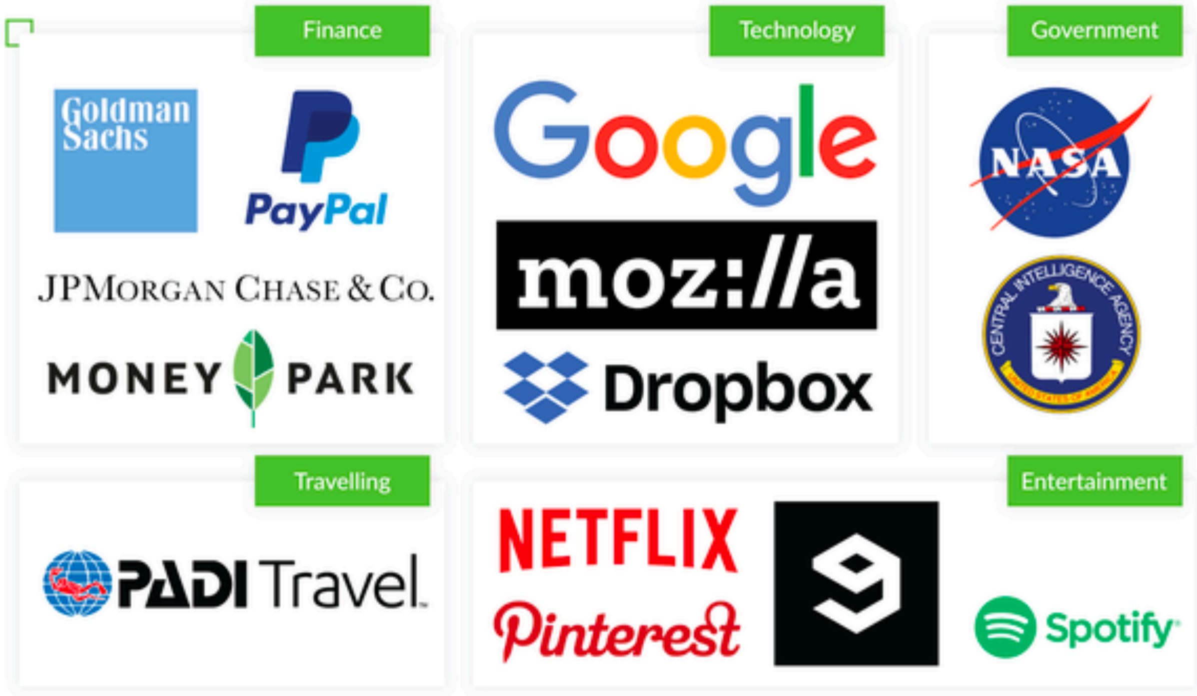

PYTHON!
YOU'RE FLYING! HOW?
I LEARNED IT LAST NIGHT! EVERYTHING IS SO SIMPLE!
HELLO WORLD IS JUST print "Hello, world!"
I DUNNO... DYNAMIC TYPING? WHITESPACE?
COME JOIN US! PROGRAMMING IS FUN AGAIN! IT'S A WHOLE NEW WORLD UP HERE!
BUT HOW ARE YOU FLYING?
I JUST TYPED import antigravity
THAT'S IT?
... I ALSO SAMPLED EVERYTHING IN THE MEDICINE CABINET FOR COMPARISON.
BUT I THINK THIS IS THE PYTHON.

Source: https://imgs.xkcd.com/comics/python.png

- Free and open source
- Python is a high-level language intended to be relatively straightforward for humans to read and write and for computers to read and process
- General-purpose programming language
- Extensive public libraries (numpy, pandas, scipy, scikit-learn, etc.)
- Python emphasizes productivity and readability

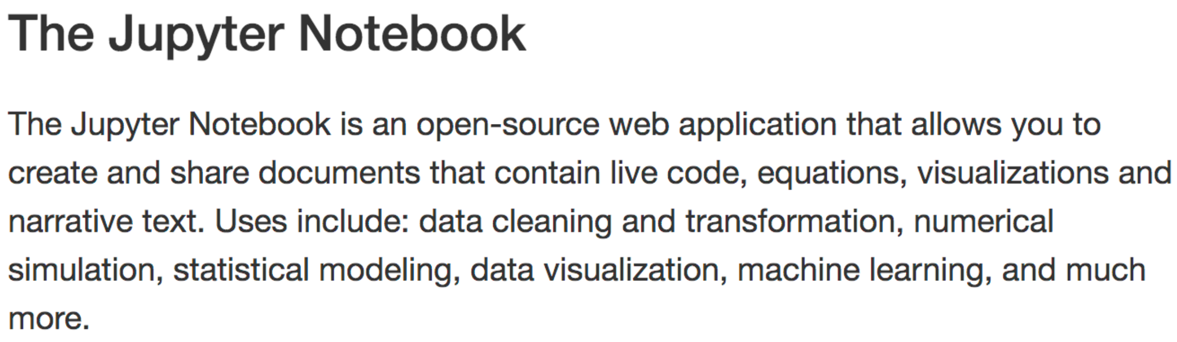
Popular usages

- **Scripting:** expressive and less bulky
- **Application Backends:** Django, Flask, and other server-side web frameworks
- **Scientific Computing:** SciPy/NumPy, Matplotlib, and Pandas
- **Desktop Applications**
- **Mobile Applications**



https://www.quora.com/What-is-Python-primarily-used-for

Intro to Jupyter (formerly, IPython) Notebook



The Jupyter Notebook

The Jupyter Notebook is an open-source web application that allows you to create and share documents that contain live code, equations, visualizations and narrative text. Uses include: data cleaning and transformation, numerical simulation, statistical modeling, data visualization, machine learning, and much more.

To run the notebook,
run the following command at the Terminal (Mac/Linux)
or Command Prompt (Windows):

```
jupyter notebook
```

Few examples of public Jupyter Notebook:

- LIGO Gravitational Wave Data
- Satellite Imagery Analysis
- 12 Steps to Navier-Stokes
- Computer Vision
- Machine Learning

+ Easy data explorations
+ Speak my language
+ Reproducibility
+ Easy online sharing

- Not as convenience as Rstudio

Personal favorite packages

NumPy

Base N-dimensional array package

SciPy library

Fundamental library for scientific computing

Matplotlib

Comprehensive 2D Plotting

pandas

$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$

SM StatsModels

Statistics in Python

Seaborn

scikits learn

machine learning in Python

jupyter

R or Python?

Opinion that I agree on the Internet (Cr: @vsbuffalo)

“**Python's main advantage and disadvantage**: it's a programming language written by computer scientists.

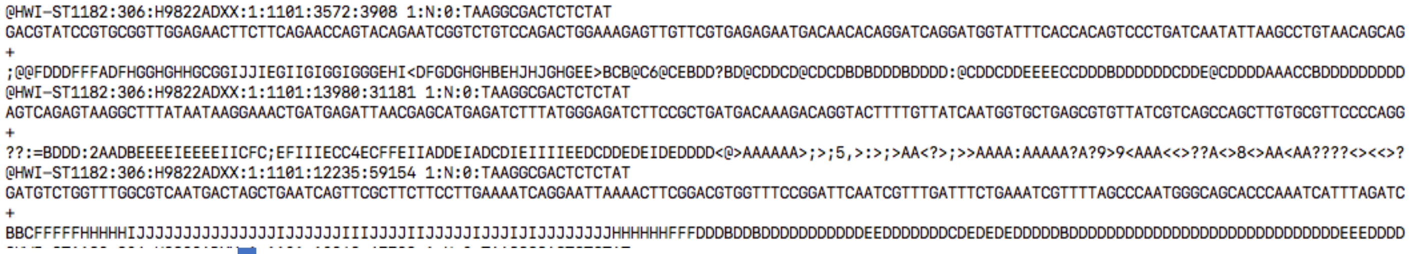
R's main advantage and disadvantage: it's a programming language written by statisticians.

Python's language features make it pretty great for a lot of things, and numpy is sort of an engineering marvel (I see why astronomy folks are so crazy for it). R has billion packages, tidyverse, bioc, and it's own nice language features (formulas!). In total:

- I ❤️ R
- I ❤️ Python”

So choose wisely:)

Practical use in research



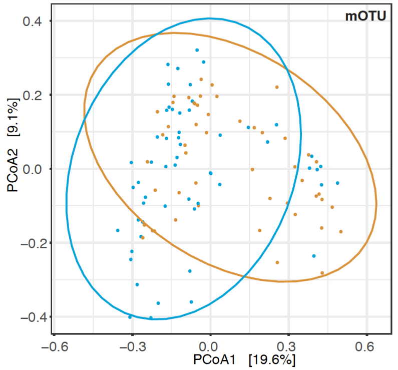
```
@HWI-ST1182:306:H9822ADXX:1:1101:3572:3908 1:N:0:TAAGGCGACTCTCTAT
GACGTATCCGTGCGGTTGGAGAACTTCTTCAGAACCAGTACAGAATCGGTCTGTCCAGACTGGAAAGAGTTGTTCGTGAGAGAATGACAACACAGGATCAGGATGGTATTTCACCACAGTCCCTGATCAATATTAAGCCTGTAACAGCAG
+
;@@FDDDFFFADFHGGHGHHGCGGIJJIEGIIGIGGIGGGEHI<DFGDGHGHBEHJHJGHGEE>BCB@C6@CEBDD?BD@CDDCD@CDCDBDBDDDBDDDD:@CDDCDDEEEECCDDDBDDDDDDCDDE@CDDDDAAACCBDDDDDDDDD
@HWI-ST1182:306:H9822ADXX:1:1101:13980:31181 1:N:0:TAAGGCGACTCTCTAT
AGTCAGAGTAAGGCTTTATAATAAGGAAACTGATGAGATTAACGAGCATGAGATCTTTATGGGAGATCTTCCGCTGATGACAAAGACAGGTACTTTTGTTATCAATGGTGCTGAGCGTGTTATCGTCAGCCAGCTTGTGCGTTCCCCAGG
+
??:=BDDD:2AADBEEEEIEEEEIICFC;EFIIIECC4ECFFEIIADDEIADCDIEIIIIEEDCDDEDEIDEDDDD<@>AAAAAA>;>;5,>:>;>AA<?>;>>AAAA:AAAAA?A?9>9<AAA<<>??A<>8<>AA<AA????<><<>?
@HWI-ST1182:306:H9822ADXX:1:1101:12235:59154 1:N:0:TAAGGCGACTCTCTAT
GATGTCTGGTTTGGCGTCAATGACTAGCTGAATCAGTTCGCTTCTTCCTTGAAAATCAGGAATTAAAACTTCGGACGTGGTTTCCGGATTCAATCGTTTGATTTCTGAAATCGTTTTAGCCCAATGGGCAGCACCCAAATCATTTAGATC
+
BBCFFFFFHHHHHIJJJJJJJJJJJJJJJIJJJJJJIIIJJJJJIIJJJJJIJJJIJIJJJJJJJJHHHHHHFFFDDDBDDBDDDDDDDDDDDDEEDDDDDDDCDEDEDEDDDDDBDDDDDDDDDDDDDDDDDDDDDDDDDDDDDDEEEDDDD
```

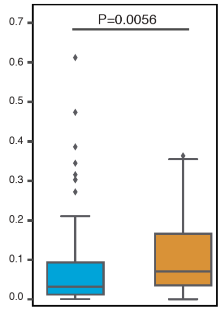
e.g. ~5GB/sample; >100samples

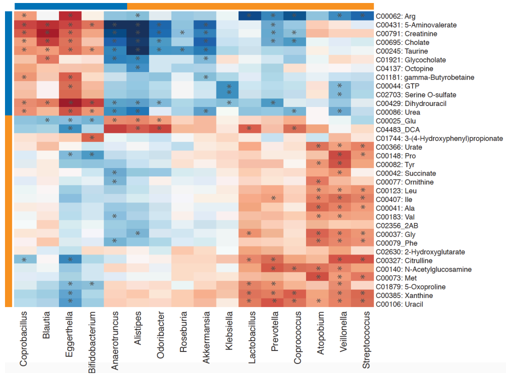
Python + bash + HPC + tons of tools + stack overflow

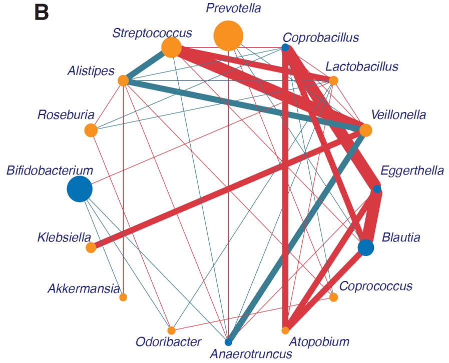
	Control 1	Control 2	Case 3	Case 4	……
Feature 1	0.05127856	0.579605386	0.360309588	0.08239625	0.360309588
Feature 2	0.065766244	0.579605386	0.354275032	0.102283303	0.354275032
Feature 3	0.065766244	0.579605386	0.08239625	0.579605386	0.08239625
…….	0.102283303	0.579605386	0.130373517	0.664904935	0.130373517
……	……..	……….	………..	………….	……….

Python + **R** + stack overflow









Let's have fun!!

‘Common error is simple, simple error is common’

Want some more?

- Self-pace get to know basic (vocabulary, simple technique)
  - codeacademy
  - R: https://www.codecademy.com/learn/learn-r
  - Python: https://www.codecademy.com/learn/learn-python-3
- Self learning sources:
  - - Free online courses:
    - udemy
    - datacamp
    - coursera

Want some more? (2)

- Learning repositories:
    - The carpentries (our main source for meeting): https://carpentries.org/ (data, software, library carpentry)
    - Kamis data (Indonesia): https://github.com/indo-r/kamisdata
    - Data is beautiful: https://www.reddit.com/r/dataisbeautiful/
    - twitter (cool UNIX/Linux command line tricks): @climagic
    - +one liner specific for bioinfo: https://github.com/crazyhottommy/bioinformatics-one-liners/blob/master/README.md
    - and many more….

- Challenge:
    - Kaggle: https://www.kaggle.com

Vote for next:

- Data wrangling (Text editing R and/or python) --> DNA Seq data will be given as default
- What statistic tools to choose in R and/or python --> multivariate tables with at least two group
- Data visualizations R vs python --> gapminder data?
- …..
- …..
- Any idea?