TEACHING STATISTICAL COMPUTING USING THE GitHub ECOSYSTEM

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JSM 2015 - Seattle

Duke University
Department of Statistical Science

STA 523 - STATISTICAL PROGRAMMING

Course details:

- First offered in Fall 2014
- Core course in Masters of Statistical Science Program
- Approximately 30 Students
  - 2/3 MSS & MSEM, 1/3 other MS & PhD
  - Divided into teams of 3-4
  - Disparate backgrounds
- Biweekly team programming assignments
- Team final project, individual final exam
- Undergraduate version in Spring 2016

TECHNICAL LEARNING OBJECTIVES

METHODOLOGICAL LEARNING OBJECTIVES

Collaboration

Reproducible Research

- R Markdown / knitr
- GNU Make

Data in the Real World

- Messy data
- Non-flat data

INFRASTRUCTURE

Dedicated departmental server

- RStudio Server Pro
- Individual departmental accounts
- System wide install of core packages

Github Organization

- 1 private repo / team (Github Education)
- Shared public repos (e.g. examples)

Continuous Integration

- TravisCI, Wercker, Drone, etc.

ASSIGNMENTS

Assignments are turned in via github (pull the repo at the deadline)

What do we get from this?

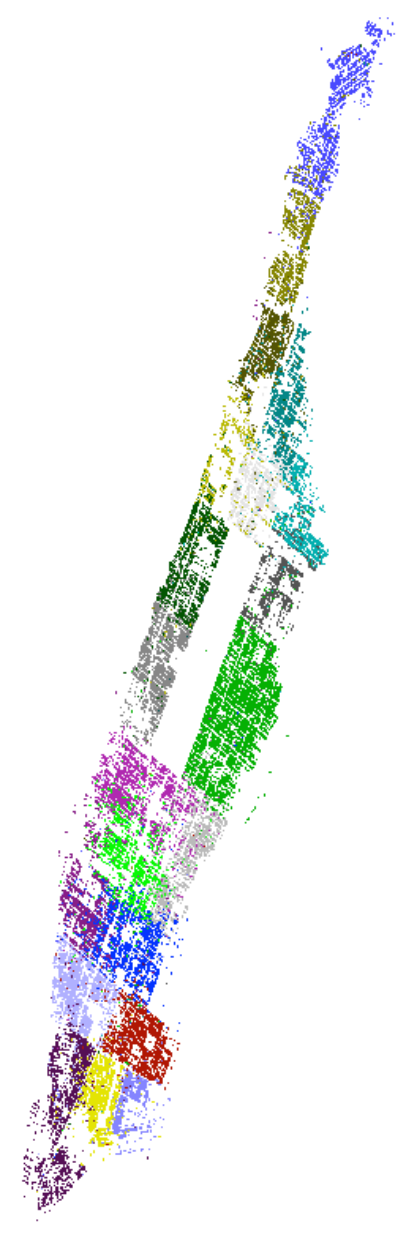
- Forces students to use version control (git)
- Simplifies course administration
  - Code / documentation / scaffolding all in the same place
  - Easy to grab files (pull)
  - Easy to distribute files (push)
- Searchability
- Accountability

EXAMPLE

- Parking violations FY2014
  9.1M tickets
- MapPLUTO (Digital Tax Map)
  43K boundaries

Goal:

- Find the boundaries of all 22 police precincts in Manhattan



Grading and feedback is given via pull requests

HW1 grading #2

Merged merged 6 commits into `master` from `hw1_grading` on Sep 29, 2014

Conversation 0 Commits 6 Files changed 18

rundel commented on Sep 29, 2014

Everything looks great, small changes and tidying of code and repo are included in the commits below.

Only very minor criticism is that you could interleave the code and write up a little bit more to improve the overall readability of the final document.

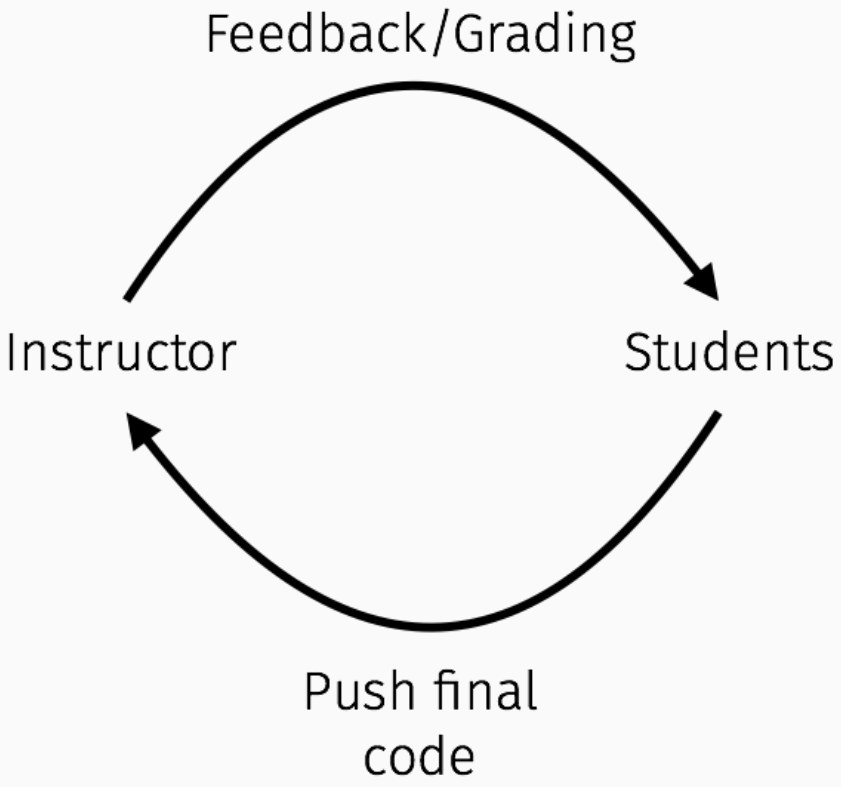
Grade: 20/20

rundel added some commits on Sep 29, 2014

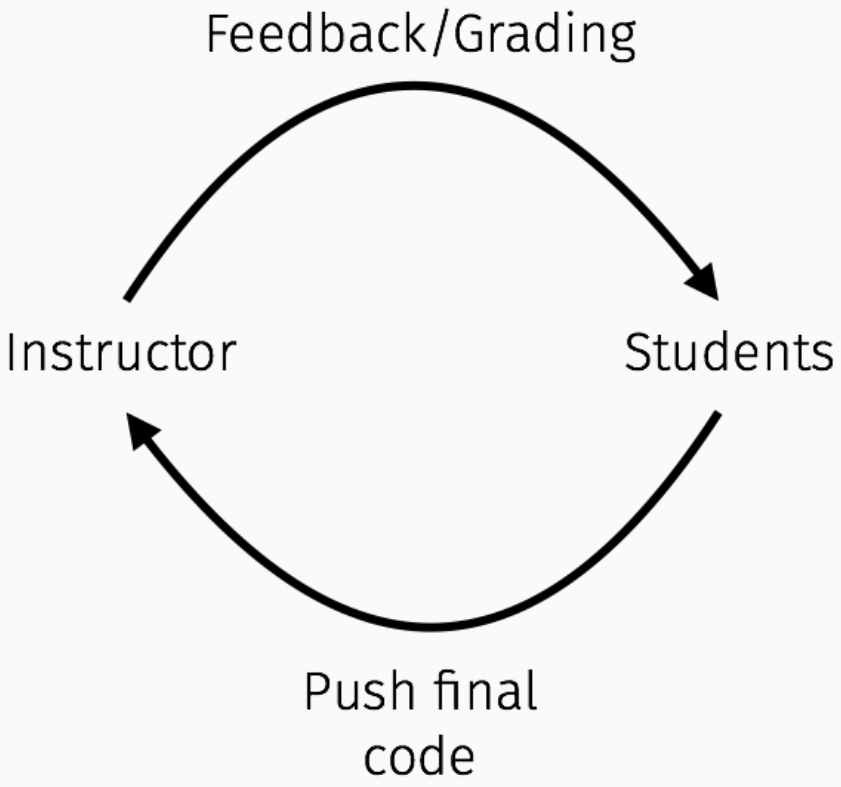
Cleanup unneeded files and .gitignore	7cdca98
Rearrange inclass work	b9db2c9
One more old file	0fcb4d2
Minor comment cleanup	6473fda
numc doesnt seem to be used elsewhere	2d0327e
Hide library load output	ca5eda1

merged commit **ec9c3fd** into `master` on Sep 29, 2014 Revert

COURSE PROCESS CARTOON

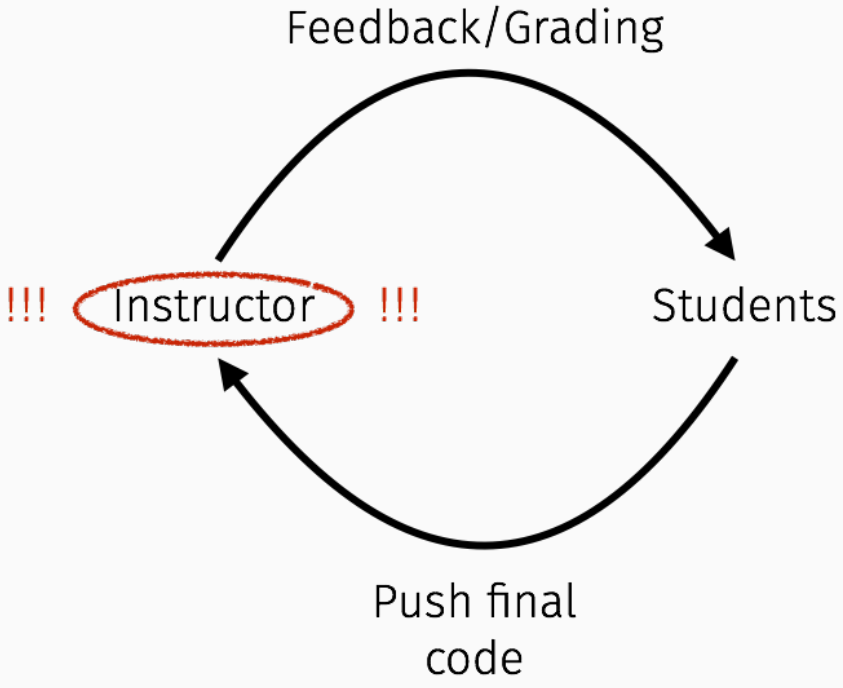


COURSE PROCESS CARTOON



Github does improve both parts of this cycle

COURSE PROCESS CARTOON



Github does improve both parts of this cycle but doesn't address the fact that *the instructor / TAs are the rate limiting step* (we don't scale well).

A PAINFULLY COMMON CONVERSATION

Student: We've submitted our HW3!

+1 Day

Me: Your Rmd file doesn't knit, you used `setwd` *with an absolute path.*

+1 Day

Student: Ok we fixed that, does it work now?

+1 Day

Me: Nope, you used `lme4` *without checking if it was installed.*

+1 Day

⋮

AUTOMATING (SOME) FEEDBACK

The is a number of fundamental details about every submission we want to check:

- the code runs, `Rmd`s knit
- the coding style is consistent
- the repo is tidy
- the code runs in a reasonable time frame
- the implementations are correct

IMPLEMENTATION?

We can take a lesson from the software engineers / developers

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Use Continuous Integration tools!

cran-comments.md	Update release notes	16 days ago
dplyr.Rproj	For speed, don't build vignettes when checking	10 months ago

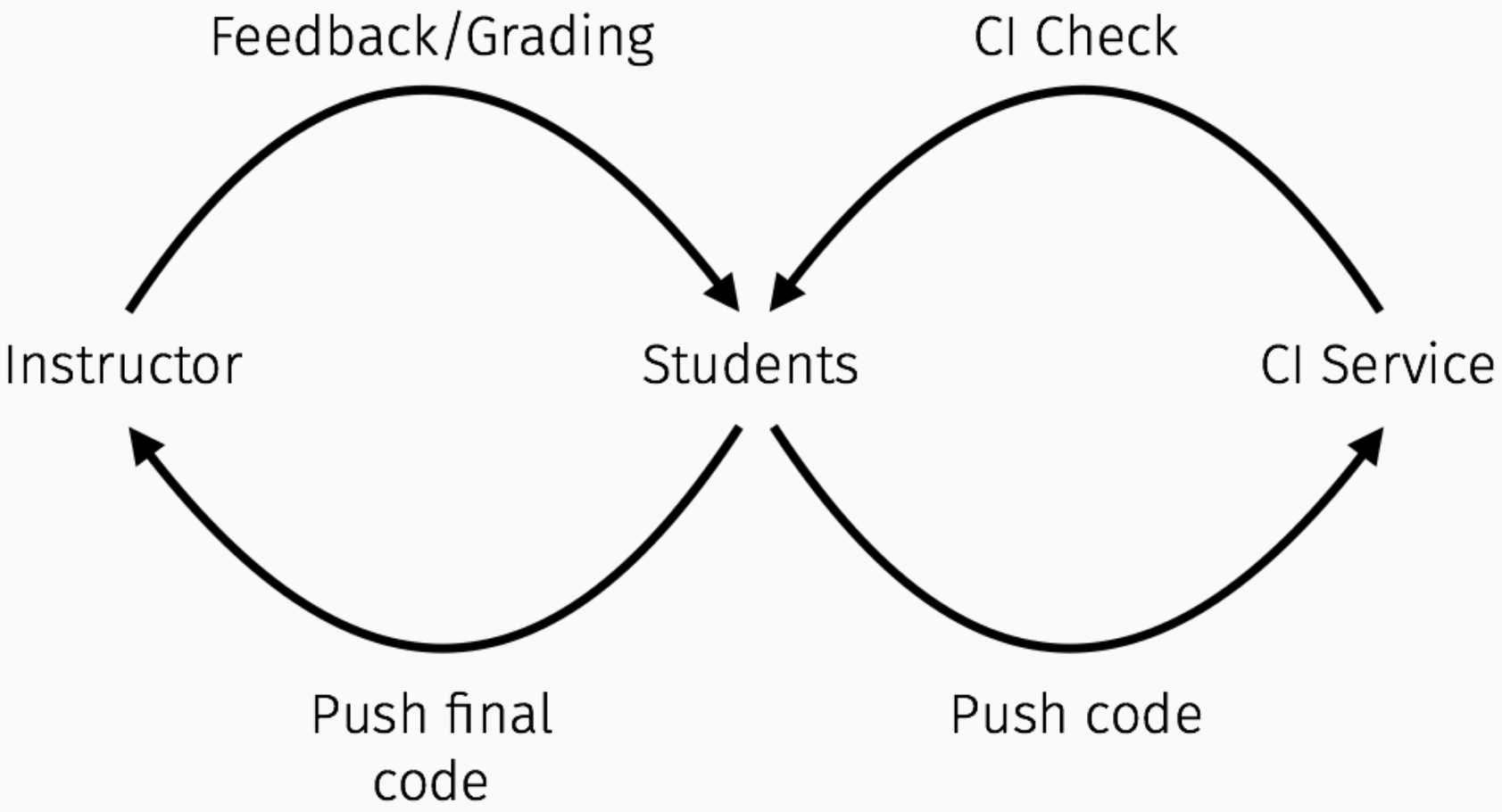
README.md

dplyr

build failing

dplyr is the next iteration of plyr, focussed on tools for working with data frames (hence the `d` in the name). It has three main goals:

COURSE PROCESS CARTOON - IMPROVED



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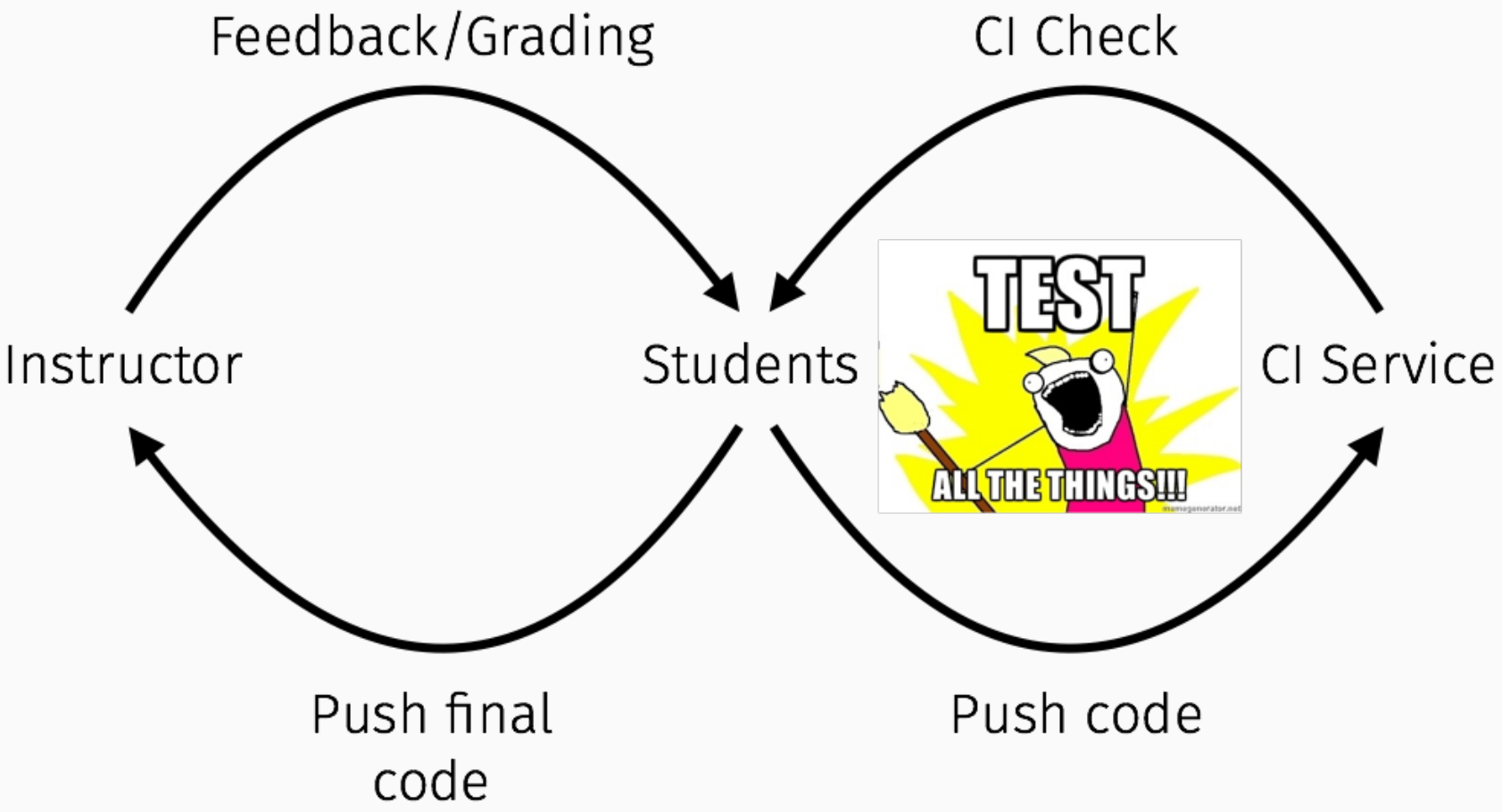

IMPLEMENTATION

This is currently more aspirational than reality, but the following is planned for the coming Fall 2015 semester.

Key details (subject to change):

- Adopting wercker for CI (uses Docker, steps)
- Enforced coding style via `lintr`
- Enforced directory structure
- Allowed file/filetype whitelist
- `testthat` for testing implementation assignments
- automated scoring of prediction contests

CONCLUSIONS

Using github gives you a lot (for free) . . .

- Version control
- Accessible web UI
- Education support
- Collaboration tools
- Search tools
- CI tools

Needs of statistical programming are very similar to the needs of the software development community

- No need to reinvent the wheel - use the existing solutions
- Teach the tools students will continue to use

QUESTIONS, COMMENTS?

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github.com/rundel/

github.com/rundel/Presentations/

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