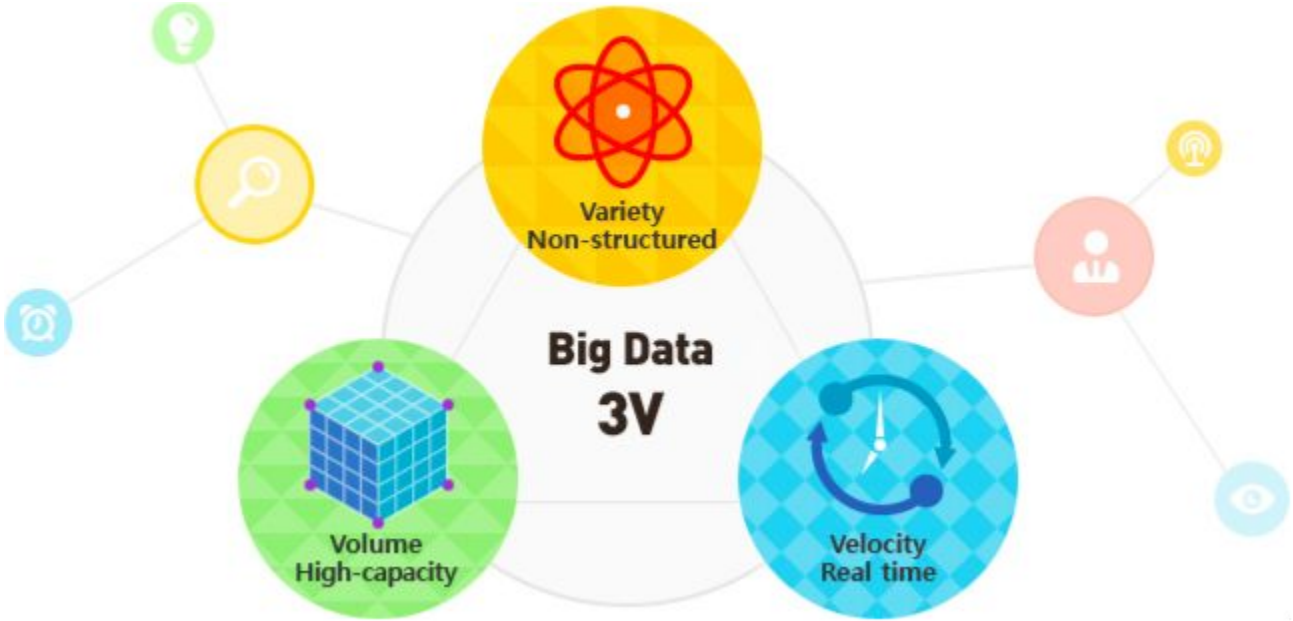
The Carpentries: Building Local and Global Communities of Practice to Improve Data Skills

Tim Dennis

AGU Fall Meeting
Dec. 13, 2019

Skills and perspectives to work with software and data are increasingly important as we generate more data.

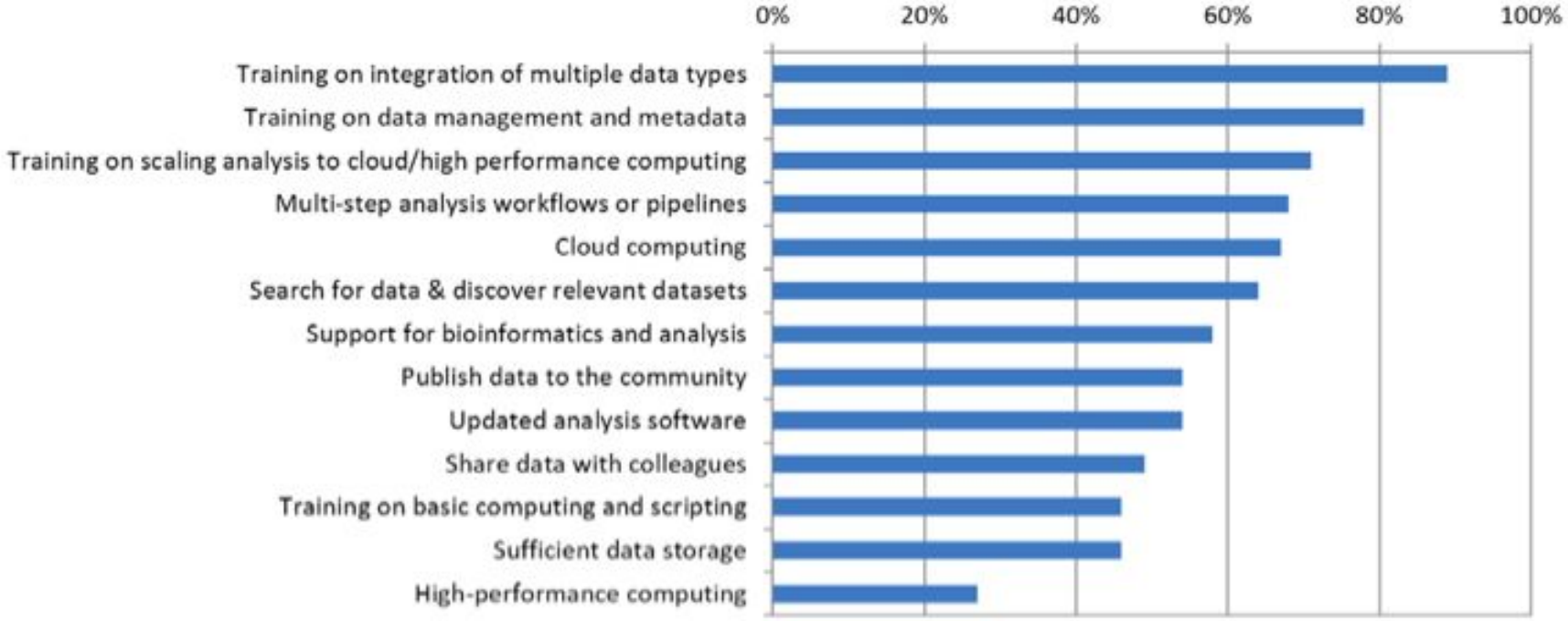


Researchers are very interested in learning these skills

Survey by Bioinformatics Resource Australia on what it would be most useful for them to offer

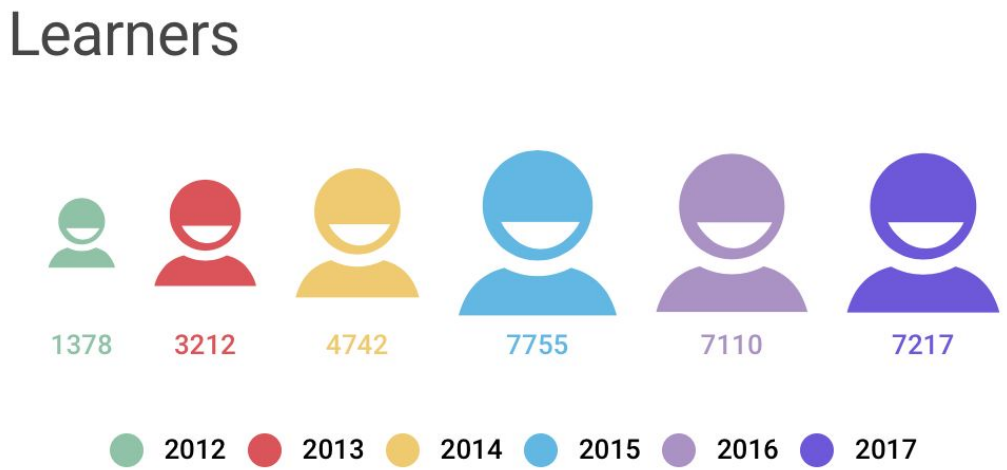
http://braembl.org.au/news/braembl-community-survey-report-2013

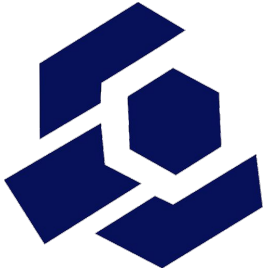
Current unmet needs



Barone L, Williams J and Micklos D. Unmet Needs for Analyzing Biological Big Data: A Survey of 704 NSF Principal Investigators (2017)

How do we scale the number of people who understand & can work with data?





THE CARPENTRIES

software carpentry

DATA CARPENTRY

library carpentry

The Carpentries is an open, global community teaching researchers the skills to turn data into knowledge.

Curriculum - Instructor Training - Community

Building Skills and Community

- Creating training ‘in the gaps’ that is accessible, approachable, aligned and applicable
- Peer-led hands-on intensive workshops
- Volunteer instructors
- Open and collaborative lesson materials
- Creating and supporting community

76 Member Organisations

38K Learners Reached

1.6K Trained Instructors

1.7K Workshops Run

7 Continents

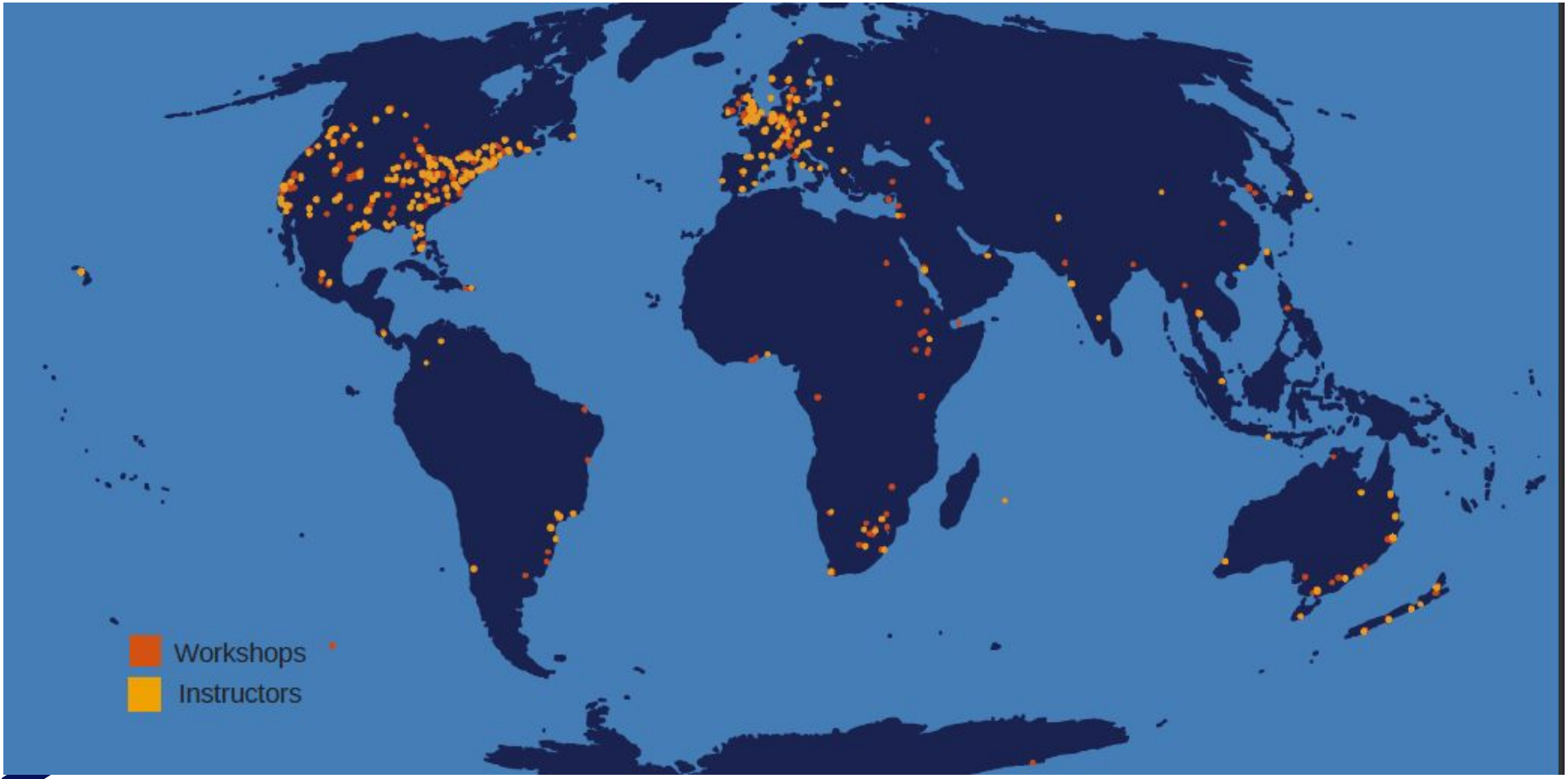
46 Countries

"In my opinion the most revolutionary thing about The Carpentries is not *what* we teach, but *how* we teach it."
- Damien Irving

"...The Carpentries is the best way to prove that it is easy to learn new skills, it is fun to do it together, and that you don't need to be a super specialist to help other people solve their problems."
- Gladys Nalvarte

"One of the reasons I got the job is that I am a qualified Software Carpentry instructor! Will definitely be using some of the materials to teach my colleagues."
-Raissa Philibert

74% of learners surveyed would recommend Carpentries workshops to a friend or colleague.


Workshops
Instructors

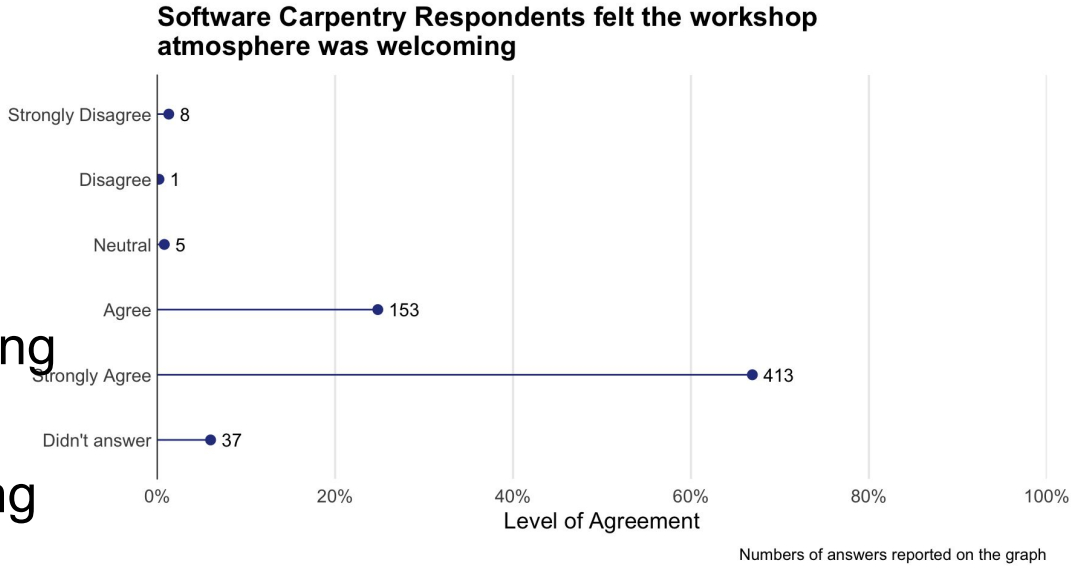
We talk about bringing compute to data or data to compute, but we need to bring people to data.

HOW?

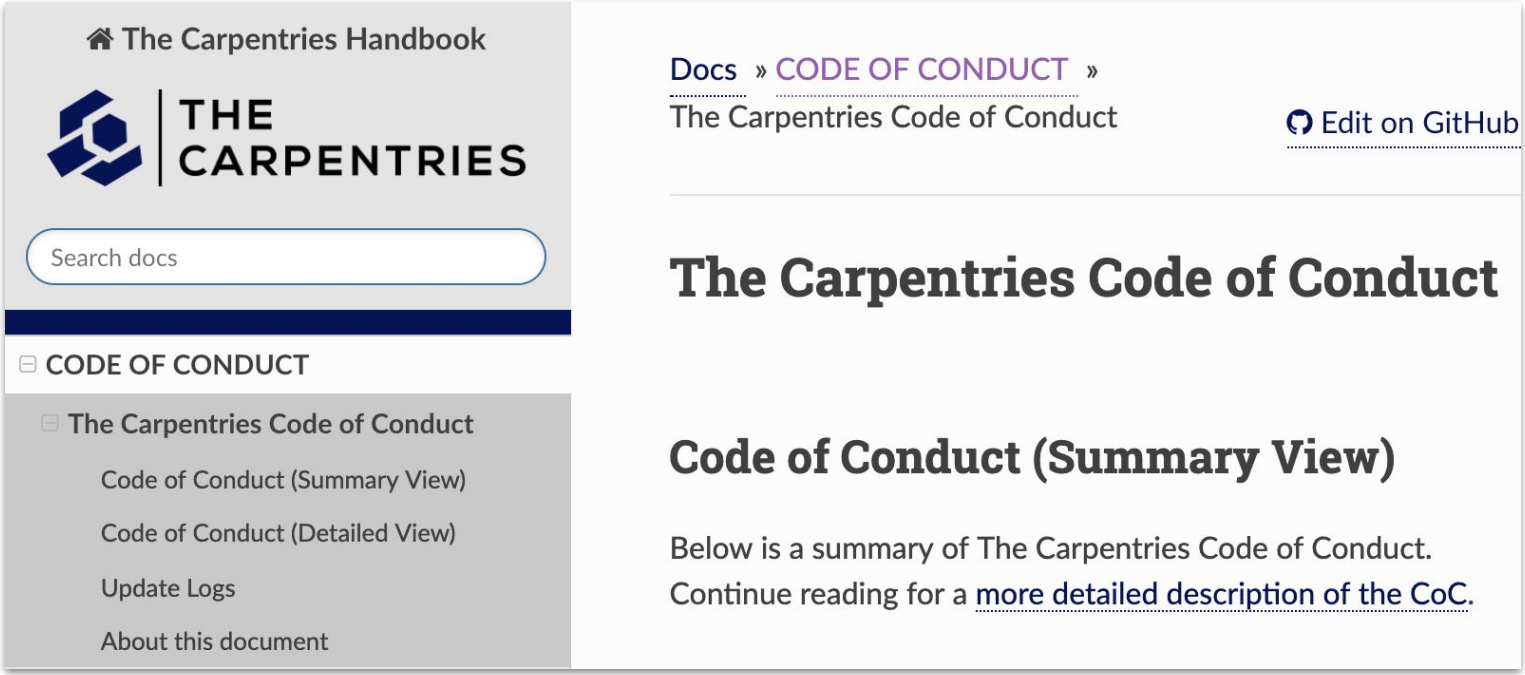
The Carpentries seek to cultivate a growth mindset in workshop participants

Positive learning environment

- Warm welcoming environment
- Peer learning reinforced in workshops
- Instructors as learners during workshops
  - reinforcing peer learning



Code of Conduct



https://docs.carpentries.org/topic_folders/policies/code-of-conduct.html

Growth mindset

- Establish the confidence that this is something you can do or continue to learn.
- Focus on effort, and incremental learning, and not outcomes.
- Seeing mistakes as opportunities for learning.
- Create safe spaces for continued learning.

Slide Credit: Tracy K. Teal, PhD - The Carpentries Executive Director

Cognitive load and formative assessment

00:00	1. Introduction to R and RStudio	How to find your way around RStudio? How to interact with R? How to manage your environment? How to install packages?
00:55	2. Project Management With RStudio	How can I manage my projects in R?
01:25	3. Seeking Help	How can I get help in R?
01:45	4. Data Structures	How can I read data in R? What are the basic data types in R? How do I represent categorical information in R?
02:40	5. Exploring Data Frames	How can I manipulate a data frame?
03:10	6. Subsetting Data	How can I work with subsets of data in R?
04:00	7. Control Flow	How can I make data-dependent choices in R? How can I repeat operations in R?
05:05	8. Creating Publication-Quality Graphics with ggplot2	How can I create publication-quality graphics in R?
06:25	9. Vectorization	How can I operate on all the elements of a vector at once?
06:50	10. Functions Explained	How can I write a new function in R?
07:50	11. Writing Data	How can I save plots and data created in R?
08:10	12. Splitting and Combining Data Frames with plyr	How can I do different calculations on different sets of data?
09:10	13. Dataframe Manipulation with dplyr	How can I manipulate dataframes without repeating myself?
10:05	14. Dataframe Manipulation with tidyr	How can I change the format of dataframes?

(suggested by @naupaka)

- 01 Introduction to R and RStudio
- 02 Project Management With RStudio
- 03 Seeking Help
- 04 Data Structures
- 05 Exploring Data Frames
- 06 Subsetting Data
- 09 Vectorization
- 08 Creating Publication-Quality Graphics with ggplot2 *OR* 13 Dataframe Manipulation with dplyr
- 15 Producing Reports With knitr

Challenge 1

Start by making a vector with the numbers 1 through 26. Multiply the vector by 2, and give the resulting vector names A through Z (hint: there is a built in vector called `LETTERS`)

Solution to Challenge 1

```R
x <- 1:26
x <- x * 2
names(x) <- LETTERS
```

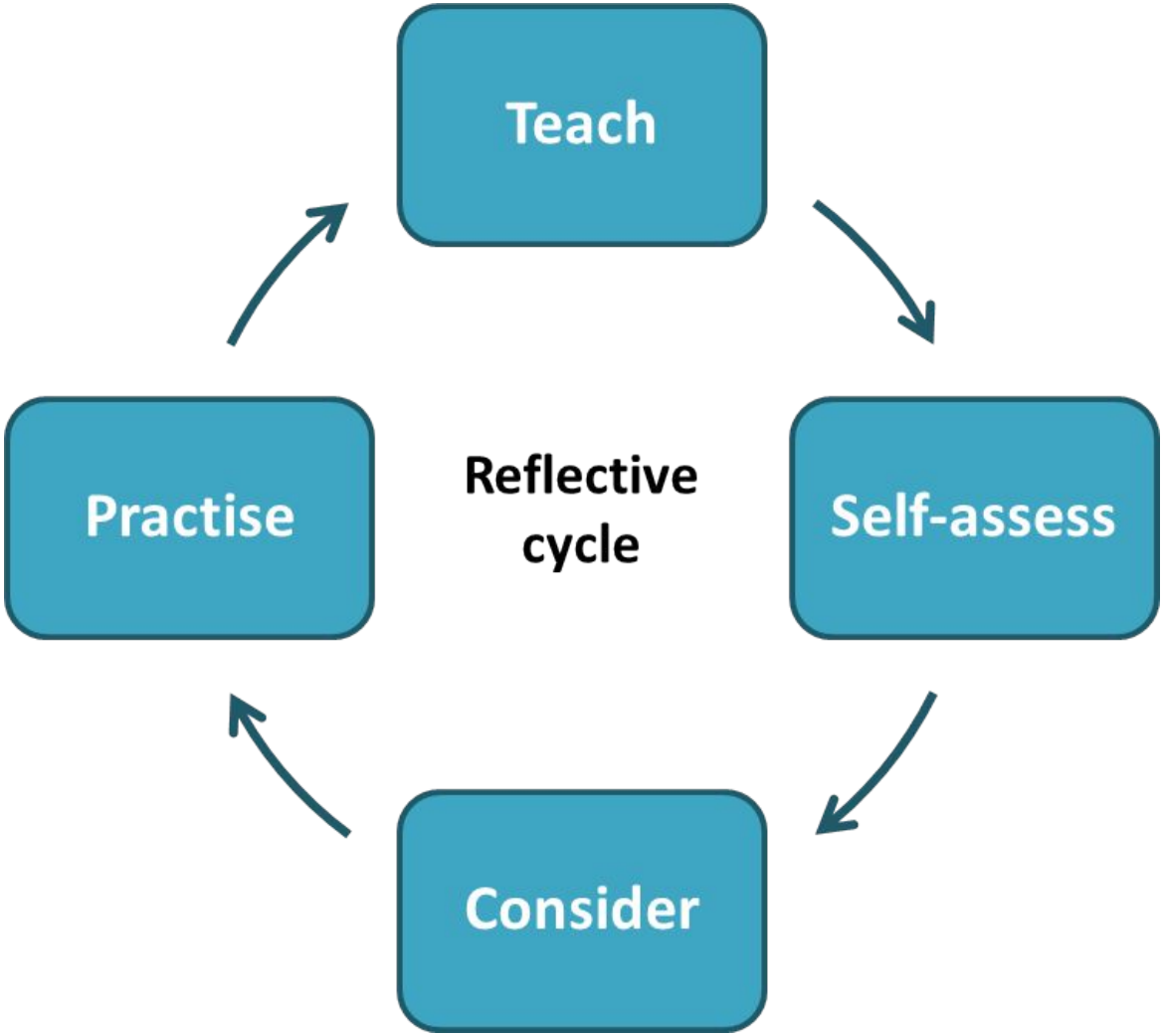
http://swcarpentry.github.io/r-novice-gapminder/

Every certified instructor has pedagogical training

- Training on evidence-based best-practices
- How to create positive learning environment
- Opportunities to practice teaching skills
- Get connected to global carpentries community

Day 1	09:00	Welcome	Who are we and how do we approach teaching? What should you expect from this workshop?
	09:15	Building Skill With Practice	How do people learn? Who is a typical Carpentries learner? How can we help novices become competent practitioners?
	10:20	Expertise and Instruction	What type of instructor is best for novices? How are we (as instructors) different from our learners and how does this impact our teaching?
	11:10	Morning Break	Break
	11:25	Memory and Cognitive Load	What is cognitive load and how does it affect learning? How can we design instruction to work with, rather than against, memory constraints?
	12:10	Building Skill With Feedback	How can I get feedback from learners? How can I use this feedback to improve my teaching?
	12:30	Lunch	Break
	13:30	Motivation and Demotivation	Why is motivation important? How can we create a motivating environment for learners?
	14:35	Mindset	How does mindset influence learning? How should we praise our learners? How should we talk about errors? What are successful habits of lifelong learners?
	15:15	Afternoon Break	Break
	15:30	Teaching is a Skill	How can I improve my teaching?
	16:40	Wrap-Up and Homework for Tomorrow	What have we learned today? What needs to be done to prepare for tomorrow?
	17:00	Finish	

https://carpentries.github.io/instructor-training/


Teach
Self-assess
Consider
Practise
Reflective cycle

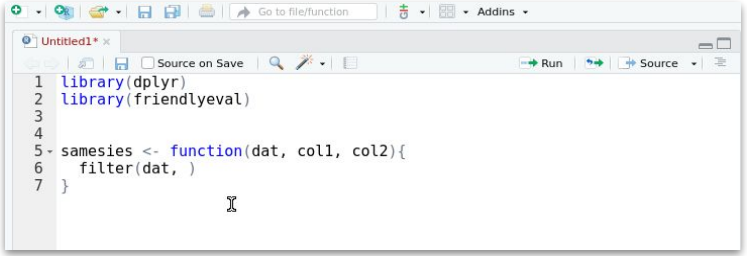
Positive Error framing

- Making mistakes is the key to learning concepts
  - Instructors and learners learning from each other

> The typos are the pedagogy.
> — Emily Jane McTavish

Teaching practices and tips

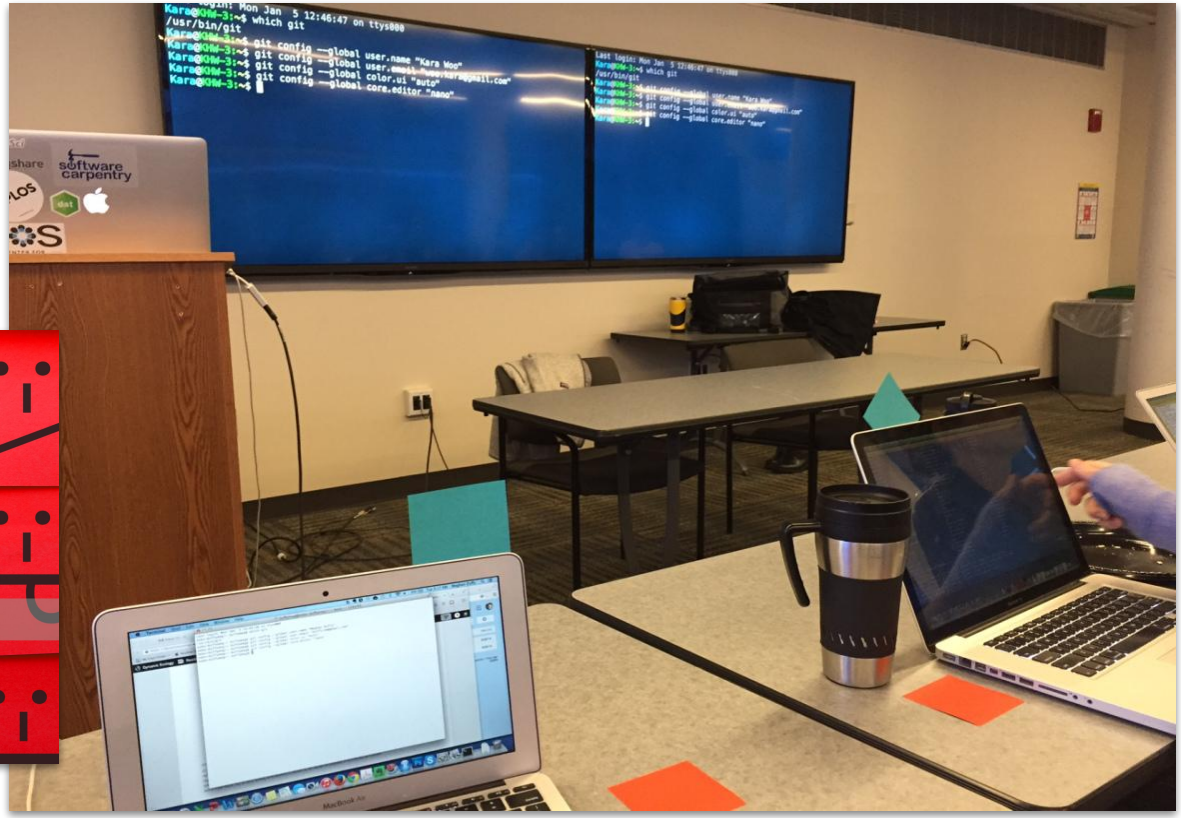
Live Coding!



- Slides aren’t used in the Carpentries
- Instructors code, correct mistakes & diagnose errors while talking through a lesson
- Learners are encouraged to follow along,
  - mimicking the instructor (“Participatory” live coding)
  - ask questions with “live” solutions

Sticky Notes!

Signaling



Sticky Notes!

Minute Cards:

Formative assessment for instructors!

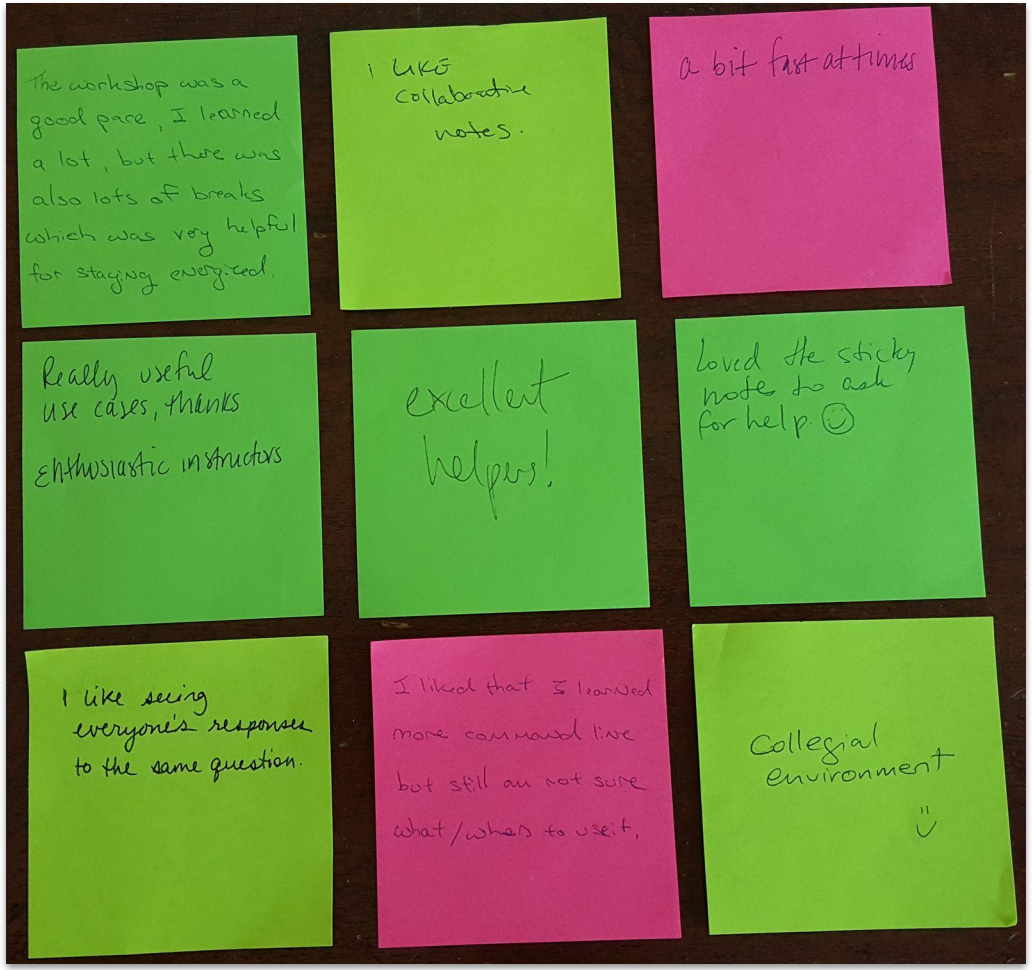
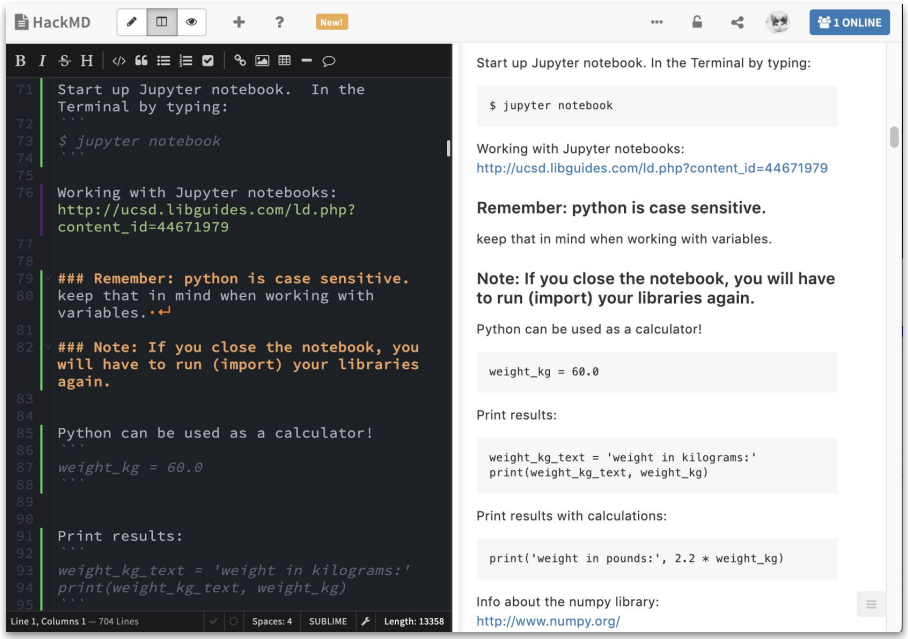


Image Credit: https://datacarpentry.org/images/stickynote.jpg

Use Peer Teaching & Programming



Collaborative note taking

Peer teaching and programming

Have learners predict outcome of demos

- Passively observing a demonstration doesn’t improve learning
- Ask your learners to predict outcomes before demonstrating the results
- Must display a public prediction (show of hands, share with neighbor, use sticky notes)

Source: https://journals.plos.org/ploscompbiol/article/file?id=10.1371/journal.pcbi.1006023&type=printable

Never teach alone!

- Co-teach when possible

- Recruit helpers for each workshop

There is no Geek Gene

"...the idea that some people are just *born* to program and those lucky few have a 'Geek Gene'"

is

"computing's most enduring and damaging myth" - **Guzdial**

Source: https://cacm.acm.org/blogs/blog-cacm/189498-top-10-myths-about-teaching-computer-science/fulltext

Conclusion

- The Carpentries inclusive pedagogy has been an effective method for teaching technical topics to novices.
- Workshops with a focus on instilling a ‘growth mindset’, so learners can gain confidence in their abilities to continue learning.
- The Carpentries inclusive pedagogy and teaching practices used to create, teach and improve on their workshops is tried and true.

Questions?

Contact:

Tim Dennis UC Los Angeles - tdennis@library.ucla.edu

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