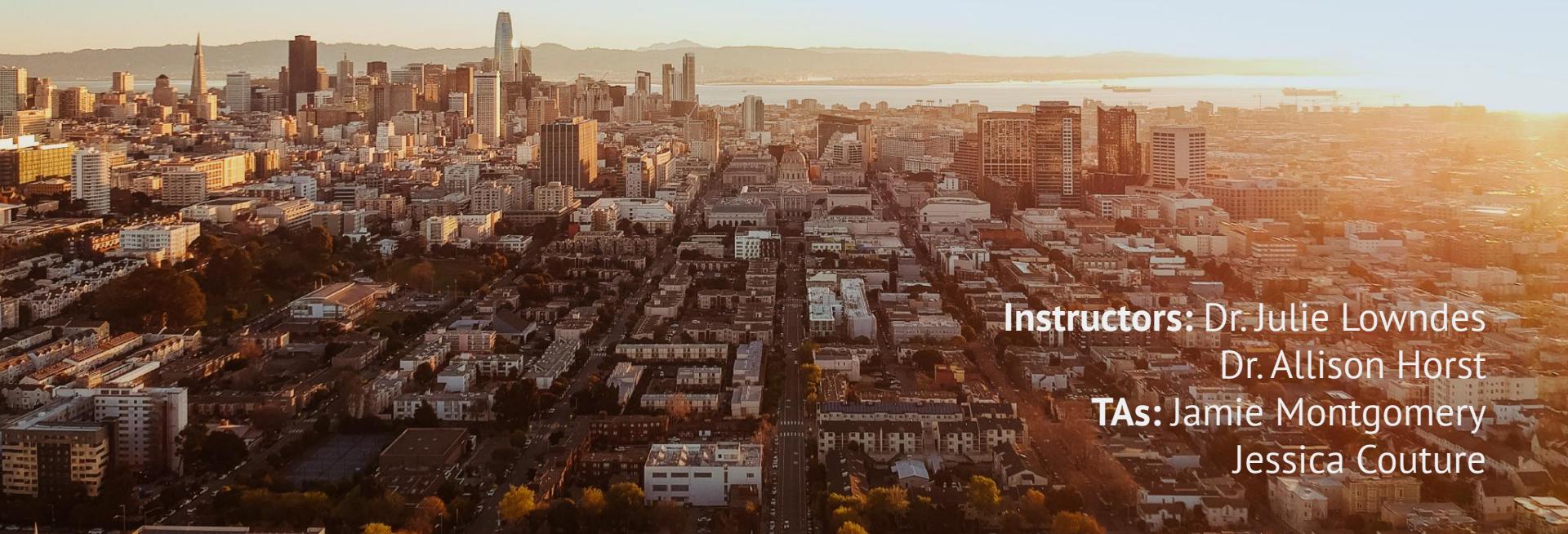


R for Excel Users

Slides accompanying workshop lessons: rstd.io/conf20-r-excel
RStudio::conf(2020)



Instructors: Dr. Julie Lowndes
Dr. Allison Horst
TAs: Jamie Montgomery
Jessica Couture

Hello!



JULIE LOWNDES

Please call me: Julie
My Twitter: [@juliesquid](https://twitter.com/juliesquid)
My GitHub: [jules32](https://github.com/jules32)
My pronouns: she/her



ALLISON HORST

Please call me: Allison
My Twitter: [@allison_horst](https://twitter.com/allison_horst)
My GitHub: [allisonhorst](https://github.com/allisonhorst)
My pronouns: she/her



JESSICA COUTURE

Please call me: Jessica
My Twitter: [@ECOTure9](https://twitter.com/ECOTure9)
My GitHub: [couture322](https://github.com/couture322)
My pronouns: she/her



JAMIE MONTGOMERY

Please call me: Jamie
My Twitter: [@jamiecmonty](https://twitter.com/jamiecmonty)
My GitHub: [jamiecmontgomery](https://github.com/jamiecmontgomery)
My pronouns: she/her

Logistics

Restrooms: by the elevator

Wifi: rstudio20, password tidyverse20

Lunch: Golden Gate Foyer (Lobby Level)

Reception: 5:30-7:30 Yosemite

Code of Conduct

Asking for help



Help please



I'm fine!



I have a question

Please put a blue sticky note on your computer if you have successfully done the following:

1. Download and install R and RStudio

- R: <https://cloud.r-project.org/>
- RStudio: <http://www.rstudio.com/download>

2. Create a GitHub account

- GitHub: <https://github.com>
- Follow optional [advice on choosing your username](#)

3. Download and install Git

- Git: <https://git-scm.com/downloads>
- Follow your operating system's normal installation process. Note: you will not see an application called Git listed

4. Download workshop data

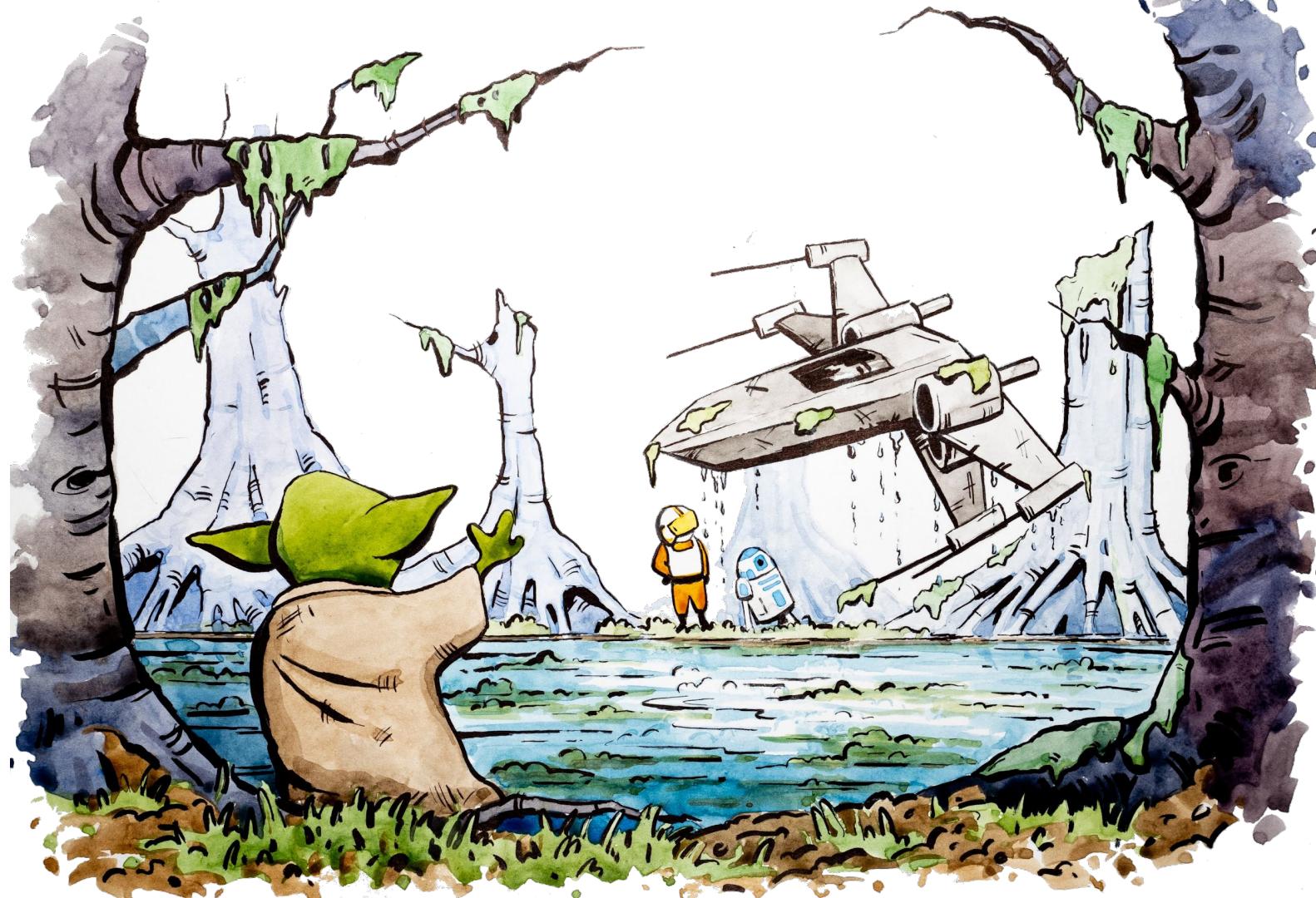
- Google Drive folder: [r-for-excel-data](#)

You are all welcome here







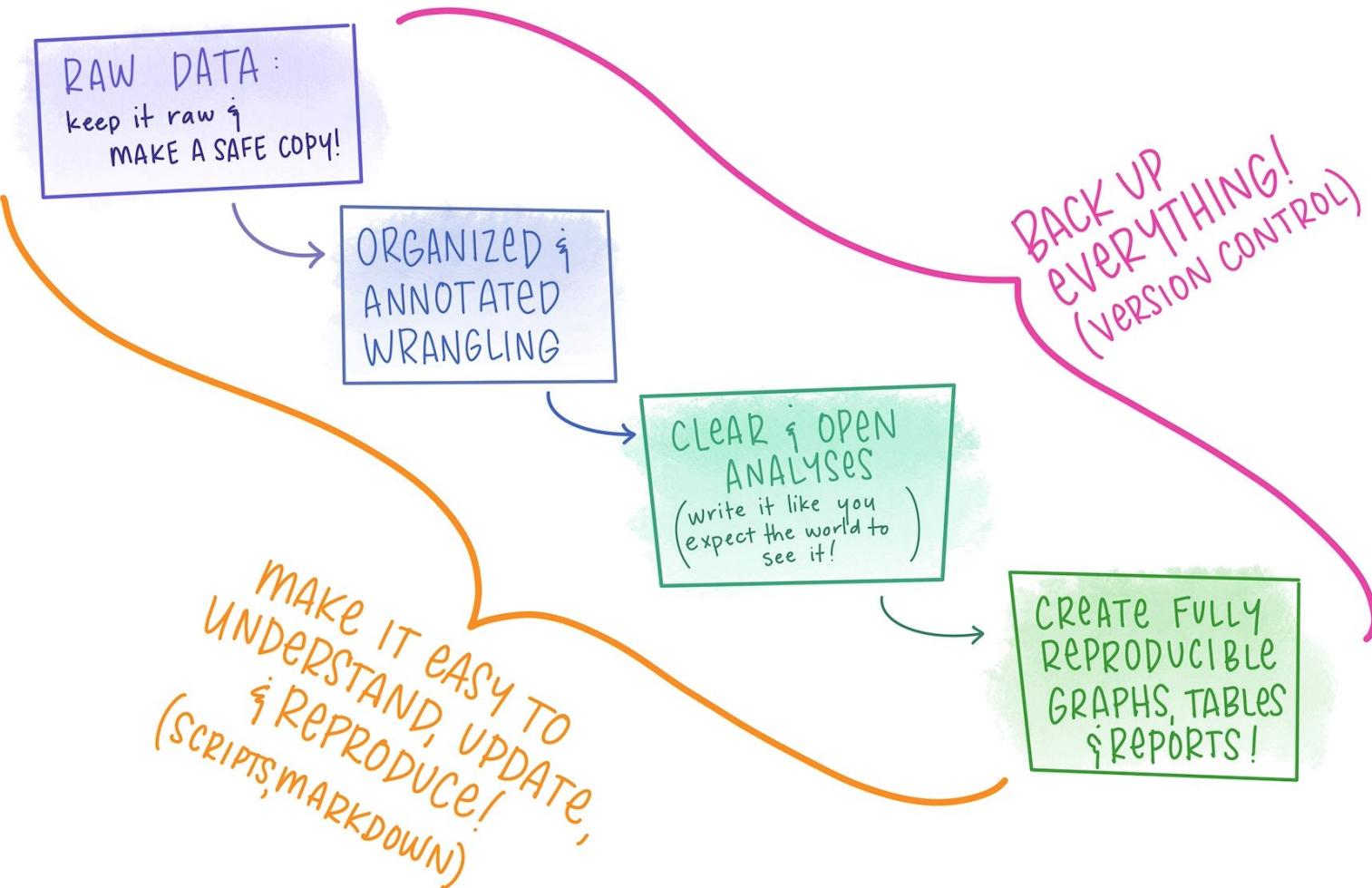




Becoming a modern useR means developing skillsets, habits, and mindsets for working in a reproducible and collaborative way

We will **learn**:

1. coding with best practices (RStudio/tidyverse)
2. collaborative bookkeeping (Git/GitHub)
3. reporting and publishing (RMarkdown/GitHub)



Our workshop data
is primarily from the
Santa Barbara Coastal
Long-Term Ecological
Research Network



[en.wikipedia.org/wiki/Channel_Islands_\(California\)](https://en.wikipedia.org/wiki/Channel_Islands_(California))

Import

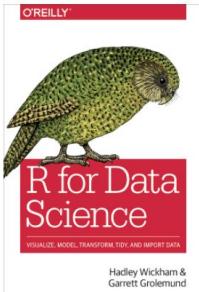
Tidy → Transform

Visualise

Model

Understand

→ Communicate



Wickham & Grolemund 2016

Import

Tidy → Transform

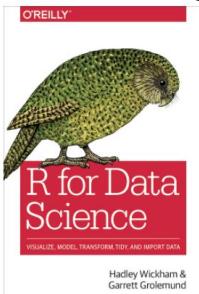
Wrangle

Understand

Visualise

Model

→ Communicate



Wickham & Grolemund 2016

Hadley Wickham &
Garrett Grolemund

Becoming a modern useR means developing skillsets, habits, and mindsets for working in a reproducible and collaborative way

We will **build the mindset**:

1. to expect that what you want to do is possible
2. to have confidence you can find it
3. to continue learning with supportive community
4. to enable others

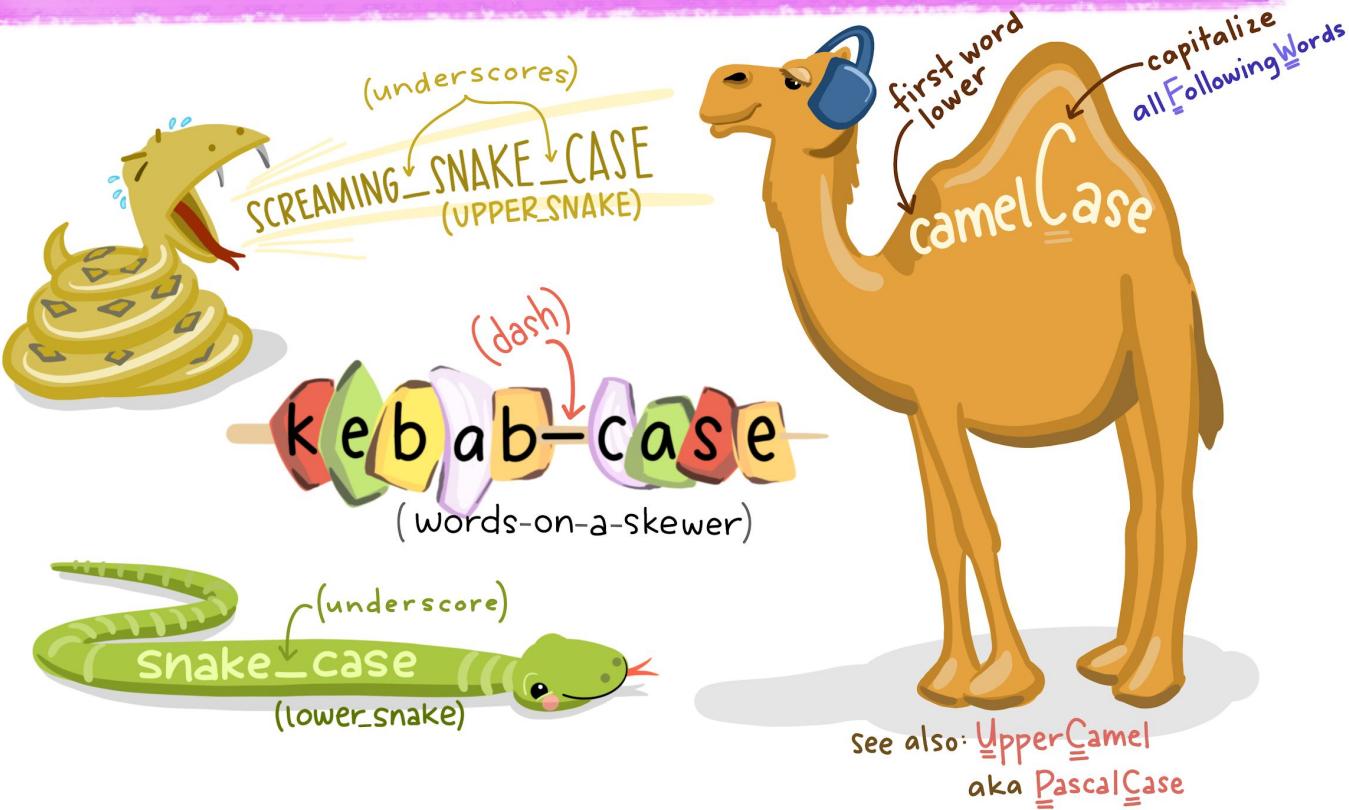
Agenda

Workshop book: rstd.io/conf20-r-excel

Time	Day 1	Day 2
9-10:30	Overview, R & RStudio, RMarkdown (JL)	Tidying (AH)
break		
11-12:30	Intro to GitHub (JL)	Filters & joins (AH)
lunch		
13:30-15:00	Graphs with <code>ggplot2</code> (AH)	Collaborating & getting help (JL)
break		
15:30-17:00	Pivot Tables & <code>dplyr</code> (JL)	Synthesis (AH)

Session 1: R, RStudio, R Markdown

in that case...





“The tidyverse is a coherent system of packages for data manipulation, exploration and visualization that share a common design philosophy.”

- Joseph Rickert
[What is the tidyverse?](#)
RStudio Community Blog



Import

readr
readxl
haven
xml2

Tidy → Transform

tibble
tidyr
dplyr
forcats
hms

purrr
magrittr

Program

Visualise

ggplot2

Model

recipes
parsnip

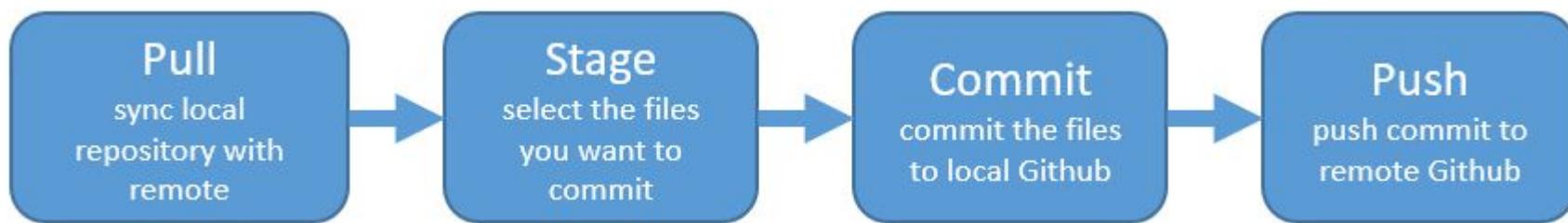
Communicate

shiny
rmarkdown

lubridate
stringr

lubridate
stringr

Session 2: GitHub



Session 3: ggplot2

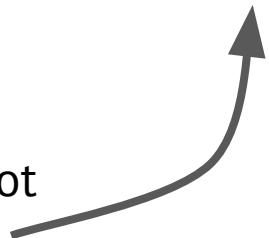
“ggplot2 is a system for declaratively creating graphics, based on [The Grammar of Graphics](#). You provide the data, tell ggplot2 how to map variables to aesthetics, what graphical primitives to use, and it takes care of the details.”

<https://ggplot2.tidyverse.org/>

1. Tell R you're using ggplot
2. What data frame are you getting the variables from?
3. What variable(s) do you want to plot?
4. What type of graph do you want to make (geom_)?

```
ggplot(data = df, aes(x = var_x, y = var_y)) +  
  geom_?()
```

plus sign between layers, not
the pipe operator!



Session 4: Pivot tables & dplyr

Wikipedia describes a pivot table as

“a table of statistics that summarizes the data of a more extensive table...this summary might include sums, averages, or other statistics, which the pivot table groups together in a meaningful way.”

Data

→ **group by**

→ **summarize**



Source: RStudio's old-school [data wrangling cheatsheet](#)

All cheatsheets available from <https://rstudio.com/resources/cheatsheets>

`data %>% group_by() %>% summarize()`



`%>%`

*The pipe operator,
reads “and then”*

“Take the data, and then
group by something, and then
summarize by something”

```
Data %>%  
  group_by() %>%  
  summarize()
```

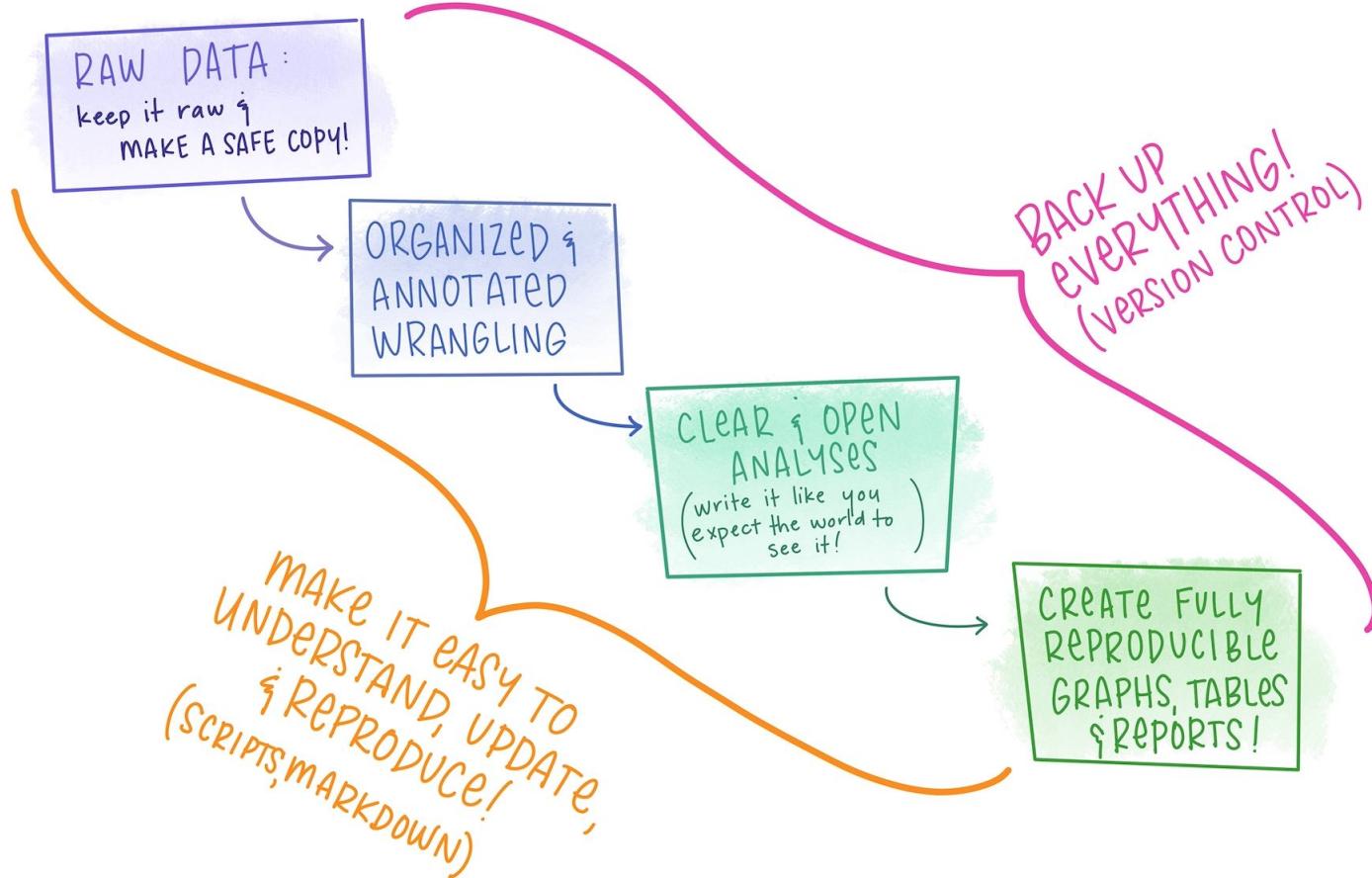
%>%

*The pipe operator,
reads “and then”*

“Take the data, and then
group by something, and then
summarize by something”

Welcome to Day 2!

If you did not get an email from me this morning with the **kelp_froonds.xlsx** file attached, please let one of us know & we'll email it to you. We'll use it for Session 2.



What we started learning yesterday:

- Meet the RStudio IDE
- Working in RMarkdown (2 languages! R + markdown)
- Functions, arguments, code syntax & good habits
- Writing organized, reproducible code, and the pipe operator (%>%)
- Installing & attaching packages
- Storing objects (<-)
- Reading in and exploring data (read_csv, read_excel)
- Intro to visualization with ggplot2
- Pivot tables (group_by + summarize)
- An html table with kable
- Hello Git + GitHub
- Work between Git and RStudio (pull > stage > commit > push)
- Whoa.

Today, continue all of that PLUS:

- Reshaping, cleaning, wrangling data continued
- Some fun with strings
- Super deliberate filtering
- Joining data frames
- Collaborating in GitHub
- Building your community
- Synthesize it!



Session 5: Tidying

What is tidy data?

From [R for Data Science](#) by Grolemund & Wickham:

To be “tidy”:

1. *Each **variable** is a column.*
2. *Each **observation** is a row.*
3. *Each **value** in its own cell.*

A **variable** is a characteristic that is being measured, counted or described with data. Like: **car type, salinity, year, population, or whale mass.**

An **observation** is a single “data point” for which the measure, count or description of one or more variables is recorded. For example, if you are recording variables *height*, *mass*, and *color* of dragons, then **each dragon** is an observation.

A **value** is the recorded measure, count or description of a variable.

Tidy data schematic, from [R for Data Science](#) by Grolemund & Wickham:

country	year	cases	population
Afghanistan	1999	745	1015071
Afghanistan	2000	2666	20595360
Brazil	1999	31737	172006362
Brazil	2000	80488	174504898
China	1999	218258	1272915272
China	2000	218766	128042583

variables

country	year	cases	population
Afghanistan	1999	745	1015071
Afghanistan	2000	2666	20595360
Brazil	1999	31737	172006362
Brazil	2000	80488	174504898
China	1999	218258	1272915272
China	2000	218766	128042583

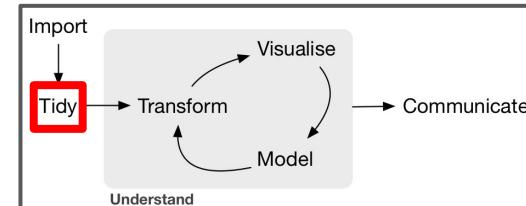
observations

country	year	cases	population
Afghanistan	1999	745	1015071
Afghanistan	2000	2666	20595360
Brazil	1999	31737	172006362
Brazil	2000	80488	174504898
China	1999	218258	1272915272
China	2000	218766	128042583

values

Tidy data

Three interrelated rules which make a dataset tidy:



Downstream operations require
tidy data

country	year	cases	population
Afghanistan	1990	45	17071
Afghanistan	2000	6666	20595360
Brazil	1999	37737	17206362
Brazil	2000	80488	174504898
China	1999	21258	1272515272
China	2000	21666	12808583

country	year	cases	population
Afghanistan	1990	45	17071
Afghanistan	2000	6666	20595360
Brazil	1999	37737	17206362
Brazil	2000	80488	174504898
China	1999	21258	1272515272
China	2000	21666	12808583

country	year	cases	population
Afghanistan	99	75	1908071
Afghanistan	00	866	2069360
Brazil	99	37737	17206362
Brazil	00	80488	174504898
China	99	21258	1272515272
China	00	21666	12808583

1. Each variable has its own column.

2. Each observation has its own row.

3. Each value has its own cell.



[Wickham & Grolemund 2016](#)

Tidy data

Untidy :(

site	1999	2000
Whitehorse	745	2666
Yellowknife	37737	80488
Inuvik	212258	213766

Good for data entry, not good for data analysis because

- data are in column headers
- not clear what the values are
- variable is spread across multiple columns
- (requires triangulation)

Tidy!!

site	year	cases
Whitehorse	1999	745
Whitehorse	2000	2666
Yellowknife	1999	37737
Yellowknife	2000	80488
Inuvik	1999	212258
Inuvik	2000	213766

Great for data analysis because

- Each variable has its own column.
- Each observation has its own row.
- Each value has its own cell.

What if you needed
Whitehorse in 2000?

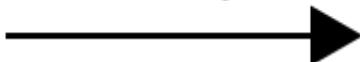
From [Software Carpentry](#):

```
pivot_longer(data = df_name,  
             cols = c(a1, a2, a3),  
             names_to = "key",  
             values_to = "value")
```

ID	a1	a2	a3
1			
2			
3			

wide format

name columns with key
and value arguments



ID	key	value
1	a1	
2	a1	
3	a1	
1	a2	
2	a2	
3	a2	
1	a3	
2	a3	
3	a3	

long format

```
pivot_wider(data = df_name,  
            values_from = value,  
            names_from = key)
```

ID	key	value
1	a1	
2	a1	
3	a1	
1	a2	
2	a2	
3	a2	
1	a3	
2	a3	
3	a3	

long format



ID	a1	a2	a3
1			
2			
3			

wide format

NOW you need kelp_fronds.xlsx

If you did not get an email from me this morning with the **kelp_fronds.xlsx** file attached, please let one of us know & we'll email it to you. We'll use it for Session 2.

Session 6: Filter & join

year	client	product	price_usd
2000	Awesome Code	book	12.99
2002	Radical R	webpage	25.50
2002	Awesome Code	book	18.25
2006	Awesome Code	movie	10.00
2013	Delightful dplyr	webpage	41.79

- “I just want to isolate rows for our *Awesome Code* client”
- “We want only data since 2005.”
- “We want *Awesome Code* book values.”

```
filter(data = df_name, variable condition(s))
```

OR

```
df_name %>%  
  filter(variable condition(s))
```

`*_join(df_x, df_y)`: deliberate merging

X

Species	Year	Count
dragon	2000	3
goose	2002	10
dog	2008	5

Y

Species	Year	Name
dragon	2004	Falcon
dog	2008	Teddy

```
full_join(x,y, by = c("Species", "Year"))
```

Species	Year	Count	Name
dragon	2000	3	NA
goose	2002	10	NA
dog	2008	5	Teddy
dragon	2004	NA	Falcon

X

Species	Year	Count
dragon	2000	3
goose	2002	10
dog	2008	5

Y

Species	Year	Name
dragon	2004	Falcor
dog	2008	Teddy

```
left_join(x,y, by = c("Species", "Year"))
```

Species	Year	Count	Name
dragon	2000	3	NA
goose	2002	10	NA
dog	2008	5	Teddy

X

Species	Year	Count
dragon	2000	3
goose	2002	10
dog	2008	5

Y

Species	Year	Name
dragon	2004	Falcor
dog	2008	Teddy

```
inner_join(x,y, by = c("Species", "Year"))
```

Species	Year	Count	Name
dog	2008	5	Teddy

Session 7: Collaborating & Getting Help

Our plan this session

- **R communities & how to effectively ask for help (30 mins)**
 - Googling. Error messages are your friends
 - How to use Twitter for #rstats
 - Create a reproducible example with `reprex`
 - GitHub Issues (brief interlude)
- **Write code collaboratively with a partner (60 mins)**
 - create a new repo and give permission to a collaborator
 - publish your web pages online!

R communities connect online and in person

Most communities have some degree of in-person and online presence, with Twitter being a big part of that online presence.

That's right: Twitter is a legit tool for learning R. We connect using the **#rstats** hashtag, and thus often called the “rstats community”.



RStudio Community

Online community forum for all questions
R & RStudio

community.rstudio.com
Also: [@RStudio](https://twitter.com/@RStudio)



R Users Group

R User Groups ("RUGs") are in-person
meetups supported by the [R Consortium](https://rconsortium.org).

local chapters

Ex: [@la_Rusers](https://twitter.com/@la_Rusers), [list of RUGs, confs](https://rconsortium.org/list-of-rugs-and-meetups)



R Ladies

World-wide organization to promote
gender diversity in the R community.

rladies.org, [@rladiesglobal](https://twitter.com/@rladiesglobal), local chapters
Also: [@WeAreRLadies](https://twitter.com/@WeAreRLadies)



rOpenSci

Building software with community; educating
scientists about transparent research practices.

ropensci.org, [@ropensci](https://twitter.com/@ropensci)
Also: [@roknowtifier](https://twitter.com/@roknowtifier), [@rocitations](https://twitter.com/@rocitations)



R4DS Community

A community of R learners at all skill levels working
together to improve our skills.

[@R4DCommunity](https://twitter.com/@R4DCommunity), [@slack](https://slack.com/r4ds)

Also: [@tidytuesday](https://twitter.com/#tidytuesday), [@R4DS_es](https://twitter.com/@R4DS_es)



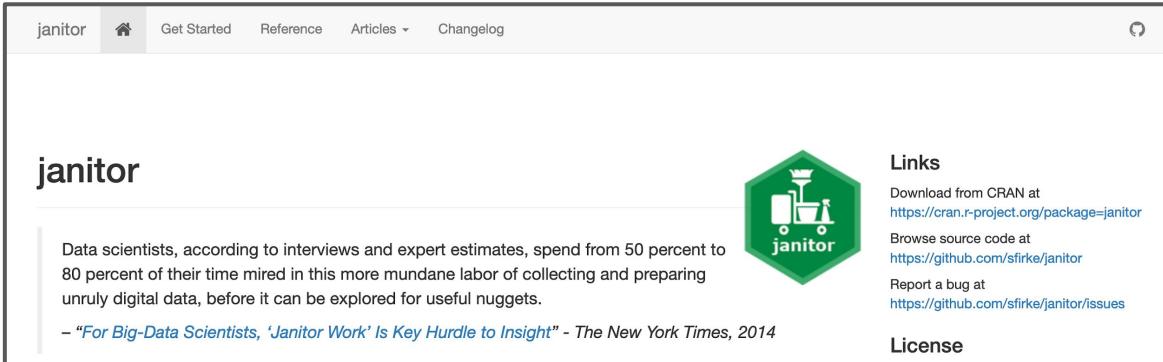
The Carpentries

Network teaching foundational data
science skills to researchers worldwide

carpentries.org, [@thecarpentries](https://twitter.com/@thecarpentries), local
workshops

Example of #rstats community awesomeness

Sam Firke's **janitor** package: sfirke.github.io/janitor



The screenshot shows the homepage of the janitor package. At the top, there is a navigation bar with links for 'janitor' (selected), 'Get Started', 'Reference', 'Articles', and 'Changelog'. Below the navigation, the title 'janitor' is displayed next to a green hexagonal logo featuring a white icon of a bucket and a broom. The main content area contains a quote: 'Data scientists, according to interviews and expert estimates, spend from 50 percent to 80 percent of their time mired in this more mundane labor of collecting and preparing unruly digital data, before it can be explored for useful nuggets.' followed by a source note: '– “For Big-Data Scientists, ‘Janitor Work’ Is Key Hurdle to Insight” - The New York Times, 2014'. Below the quote, there is a section for package metrics: 'build passing', 'coverage 100%', 'lifecycle stable', 'CRAN 1.2.1 – 3 days ago', 'downloads 17K/month', and 'downloads 293K'. A paragraph explains the package's purpose: 'janitor has simple functions for examining and cleaning dirty data. It was built with beginning and intermediate R users in mind and is optimized for user-friendliness. Advanced R users can already do everything covered here, but with janitor they can do it faster and save their thinking for the fun stuff.' A list of main functions follows: 'perfectly format data.frame column names;', 'create and format frequency tables of one, two, or three variables - think an improved `table()` ; and', and 'isolate partially-duplicate records.'. A note at the bottom states: 'The tabulate-and-report functions approximate popular features of SPSS and Microsoft Excel.'

Openly shared with a website made with RStudio's **packagedown** (RMarkdown)

I just learned about janitor's
[excel_numeric_to_date](#)

How? from Twitter:



A screenshot of a Twitter post from Tyson Barrett (@healthandstats). The post includes a profile picture of Tyson, his handle '@healthandstats', and a message: 'If you haven't used the janitor::excel_numeric_to_date() function, it is just one of those things that make life easier 😅😊😊'. Below the message, there are three laughing face emojis. The timestamp '2:13 PM · Jan 22, 2020 · Twitter Web App' is at the bottom.



Using Twitter for R

Matt Harris
@Md_Harris

Following

"It seems to rain a lot around here."

code: [gist.github.com/mrecos/fa27547 ...](https://gist.github.com/mrecos/fa27547)

Thx @sckottie for rnoaa 🎁

Yearly Deviation from Median Precipitation: 1948 to 2018
Philadelphia International Airport

Precipitation (cm)

Month

My internal monologue:

1. Cool visualization!
2. I want to represent my data this way
3. He includes his [code](#)!
4. Package from @sckottie at [rOpenSci](#)
5. **rnoaa** is a package making NOAA data more accessible!

Click images to link to Tweets

Using Twitter for R



Jenny Bryan
@JennyBryan

Following

Do you use `readxl`? Now is a good time to test drive the dev version on GitHub; it goes to CRAN soon. #rstats

I'm also on the hunt for public spreadsheets that are large enough to test and justify a `readxl` progress indicator. Suggestions?



tidyverse/readxl

Read excel files (.xls and .xlsx) into R . Contribute to tidyverse/readxl development by creating an account on GitHub.
github.com



Jamie Montgomery
@jamiecmonty

Hey #rstudioconf new job announcement! The new Masters in Environmental Data Science (MEDS) program @brenucsb is looking for a tenure track faculty member in Environmental Data Science! #edsjobs #rladies



Tenure Track Teaching Faculty in Environmental Data Science
University of California Santa Barbara is hiring. Apply now!
 recruit.ap.ucsb.edu

10:05 AM · Jan 28, 2020 · Twitter for iPhone

Strategies for learning: with community

 **Lydia White** @LWhiteScience · Apr 10
Question for R experts and R beginners! My lab mates have asked if I could run a few workshops on different R techniques (ggplot graphs, maps, etc). For the experts, if you've taught a workshop before, what are your tips for having it be successful?

 42  28  116 

 **Jamie Afflerbach** @jafflerbach · Apr 10
I had the same interest from colleagues a few years ago. I taught one session on spatial analysis in R tailored to their needs - specifically demoed a start to end analytical process modeled after their aquaculture work.

 2   4 

 **Jamie Afflerbach**
@jafflerbach

 Following

Replying to @jafflerbach @LWhiteScience

People were into it and others wanted to teach and learn new R skills specifically for environmental science. This quickly turned into [@ecodatasci](#) and now we have sessions monthly taught by others and over 200 members!

8:04 AM - 10 Apr 2019

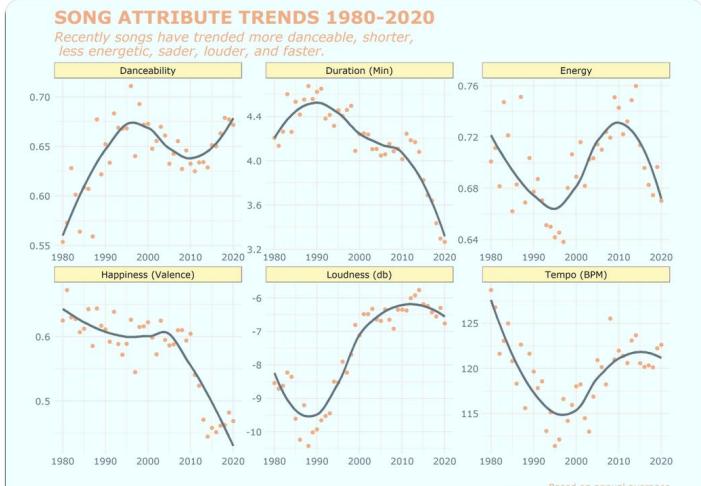
 **Ian Bell**
@lan_Bellio

#TidyTuesday Spotify Song Data

Got to use pivot_longer for the first time! In the last 30 years, the average song length has decreased by over a minute! 🤖

Code: github.com/iandouglasbell...

SONG ATTRIBUTE TRENDS 1980-2020
Recently songs have trended more danceable, shorter, less energetic, sadder, louder, and faster.



Based on annual averages
Data by Spotify via spotifyr package
#TidyTuesday @ian_Bellio

3:45 PM · Jan 21, 2020 · Twitter Web App

How to Twitter (in my opinion, for #rstats)

Be deliberate. Curate who you follow and start by listening.

I use Twitter deliberately for R and science communities, so that is the majority of the folks I follow



(but I also follow Mark Hamill. [@HamillHimself](https://twitter.com/HamillHimself)).

Mark Hamill @HamillHimself

How to Twitter (in my opinion, for #rstats)

If you're joining twitter to R, I suggest following:

- [@hadleywickham](#)
- [@JennyBryan](#)
- [@rOpenSci](#)
- [@WeAreRLadies](#)

Also check:

- #rstats
- #rstudioconf

You can also follow us:

- [@juliesquid](#)
- [@allison_horst](#)
- [@jamiecmonty](#)
- [@ECOuture9](#)

Getting help

Helping you help yourself means moving beyond “it’s not working” and towards solution-oriented approaches.

Part of this is the **mindset where you expect that someone has encountered this problem before ...**

and that **the problem is likely your typo or misuse**, and not that R is broken or hates you.

```
library(tidyverse) # also attaches tidyR

smiths ## data loaded with tidyR
#> # A tibble: 2 × 5
#>   subject time    age weight height
#>   <chr>    <dbl> <dbl>  <dbl>  <dbl>
#> 1 John     Smith  1     33    90     1.87
#> 2 Mary     Smith  1     NA     NA     1.54

smiths %>%
  separate(subject, into = c("first", "last"))
Error: 'separate' is not an exported object from  
'namespace:tidyR'
```

```
``` r
library(tidyverse)
ggplot(cars, aes(speed, dist)) +
 geom_point()
```

```

! [] (<https://i.imgur.com/g4ePv15.png>)

^{Created on 2020-01-28 by the [reprex package] (<https://reprex.tidyverse.org>) (v0.3.0)}

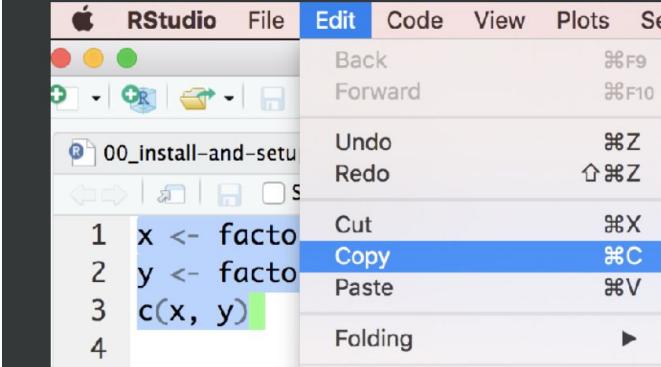
Our process:

- Read the error message.
- Paste error message into Google:
 - Error: 'seperate' is not an exported object from 'namespace:tidyr'
- Refine Google search (abstract/divorce from your exact problem):
 - Error: is not an exported object from r
- Click on RStudio Community Post:
 - Error: 'items' is not an exported object from 'namespace:cfsales'
 - “Could it be because the .rda is called item rather than items?”
- Double-check **seperate** for typos, use RStudio’s autocomplete, copy-paste the function name
- Whew.

reprex

reproducible examples

1. Copy code.



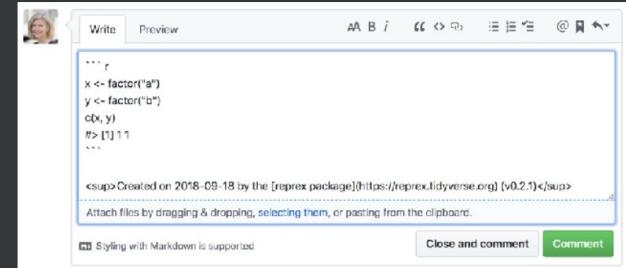
2. Run reprex().

```
> reprex()
Rendering reprex...
Rendered reprex is on the clipboard.
```

3. Admire, locally.



4. Paste into target.



5. Wait for help.



Issues in the wild

“traditional” and “less traditional”

Bug reports, code, feature, & help requests

The screenshot shows the GitHub repository page for tidyverse/ggplot2. At the top, it displays 326 stars, 1,374 forks, and 146 open issues. A prominent message encourages users to submit issues by reading contributing guidelines. Below this, a search bar filters for open issues, and a list of four recent pull requests is shown.

| Issue # | Title | Author | Opened |
|---------|---|-------------|-------------|
| #3159 | Feature request: rlang/purrr-style anonymous functions in stat_function | dkahle | 5 days ago |
| #3158 | Don't export LayerSf | clauswilke | 6 days ago |
| #3145 | Make legend glyphs configurable | clauswilke | 12 days ago |
| #3142 | geom_bar() / geom_col() erroneously warn that they ignore width aesthetic | richierocks | 14 days ago |

Project submissions and progress tracking

The screenshot shows the GitHub repository page for MozillaFestival/mozfest-program-2018. It features a message about submitting issues, followed by a search bar and filter options. A list of four issues is displayed, each with a title, author, and a link to the pull request.

| Issue # | Title | Author | Opened |
|---------|---|-------------|--------------|
| #746 | Build your own private by design voice assistant | Saalen | Sep 7, 2018 |
| #745 | Miniature Glass Room | marcwalsh | Aug 29, 2018 |
| #739 | Constructing the "don't do evil" company but this time for real | mozfest-bot | Aug 3, 2018 |

Private conversations and archiving

The screenshot shows the GitHub repository page for OHI-Science/globalfellows-issues. It lists three issues, all of which are marked as closed. Each issue has a title, author, and a link to the pull request.

| Issue # | Title | Author | Opened |
|---------|---|------------|--------------|
| #56 | Final data things for ohi 2018 assessment | Melsteroni | Sep 19, 2018 |
| #57 | Cleaning ohicore | Melsteroni | Sep 19, 2018 |
| #54 | Cleaning ohi-global | Melsteroni | Sep 18, 2018 |

Session 8: Synthesis

Before you leave, please take this short survey
(also available in the conference app)

rstd.io/ws-survey

And we will give out stickers

my github repo:

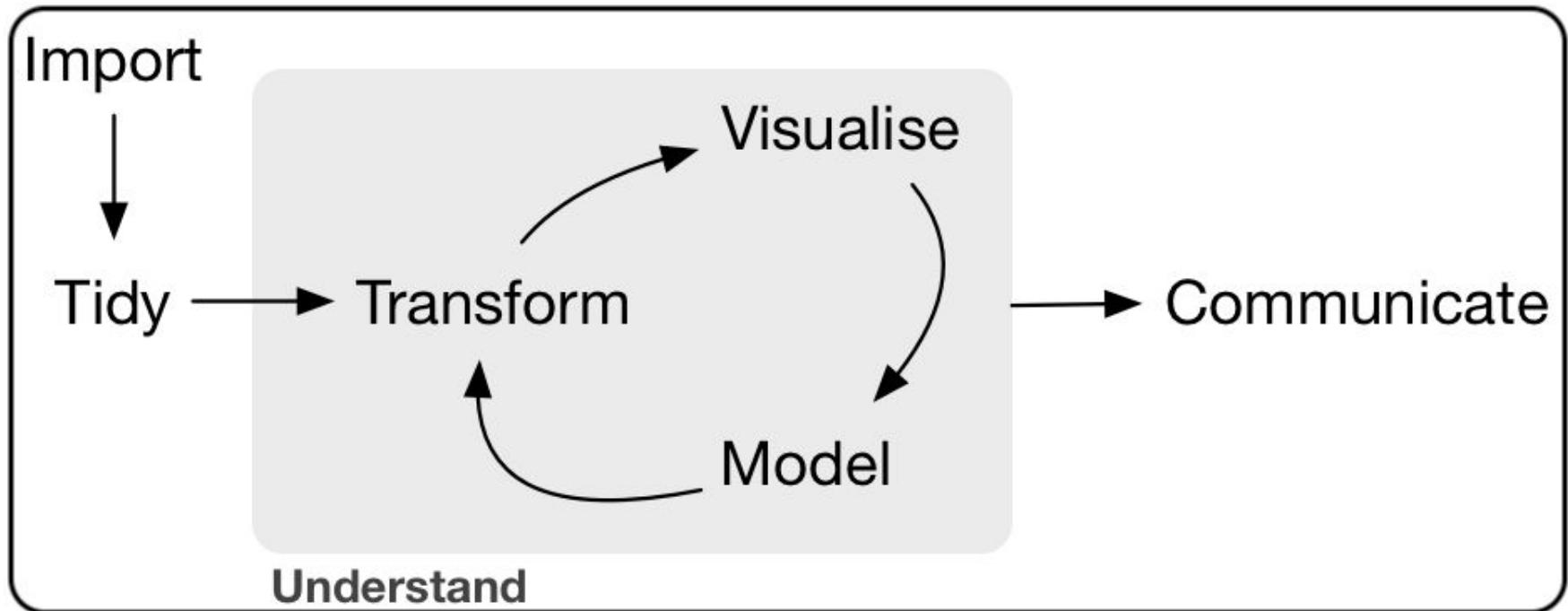
<https://github.com/jules32/r-collab/>

my website url:

<https://jules32.github.io/r-collab/>

Closing (10 min)

Overall, our system:



What you did in this workshop:

- Meet the RStudio IDE
- Working in RMarkdown (2 languages! R + markdown)
- Functions, arguments, code syntax & good habits
- Writing organized, reproducible code, and the pipe operator (%>%)
- Installing & attaching packages
- Storing objects (<-)
- Reading in and exploring data (read_csv, read_excel)
- Reproducible file paths with 'here'
- Intro to visualization with ggplot2
- Pivot tables (group_by + summarize)
- An html table with kable
- Hello Git + GitHub
- Work between Git and RStudio (pull > stage > commit > push)
- Reshaping, cleaning, wrangling data continued
- Fun with strings
- Deliberate filtering
- Joining data frames
- Collaborating in GitHub (co-working, a merge conflict!)
- Building your community (and yes we discussed how to Twitter!)
- Synthesis!
- Publish document as a web page
- tidyverse
- ggplot2
- readr
- readxl
- dplyr
- tidyr
- stringr
- here
- janitor
- kableExtra
- R
- RStudio
- Git
- GitHub

Error messages should not feel defeating

- Everyone gets them. At all levels. All the time.
- **Just because it's red doesn't mean it's personal.**
- After a while we start seeing these as more useful, and develop tools to more strategically troubleshoot.
- Whenever possible, have error messages feel like:
 - A useful heads up
 - An opportunity to learn something
 - A puzzle that you can solve

Where to go from here?

- **Main tool:** Google it...strategically
- [CRAN Task view](#)
- [rOpenSci](#)
- The Carpentries: <https://carpentries.org/>
- Join #rstats community on twitter, even if **just** for the #rstats!

Some starting-point resources:

- R4DS [book](#) & [online learning community](#)
- [RStudio community](#)
- Our workshop book! <https://rstudio-conf-2020.github.io/r-for-excel>
- Materials from other RStudio::conf tutorials (e.g. tidyverse)
- Blog posts, tutorials, vignettes on packagedown pages (e.g. [janitor](#))
- [Webinars](#) & slide decks (e.g. RStudio::conf Keynote [Jenny Bryan](#))
- Podcasts e.g. [NSSD Spreadsheet Drama](#) (by RStudio::conf Keynote Hilary Parker & Roger Peng)

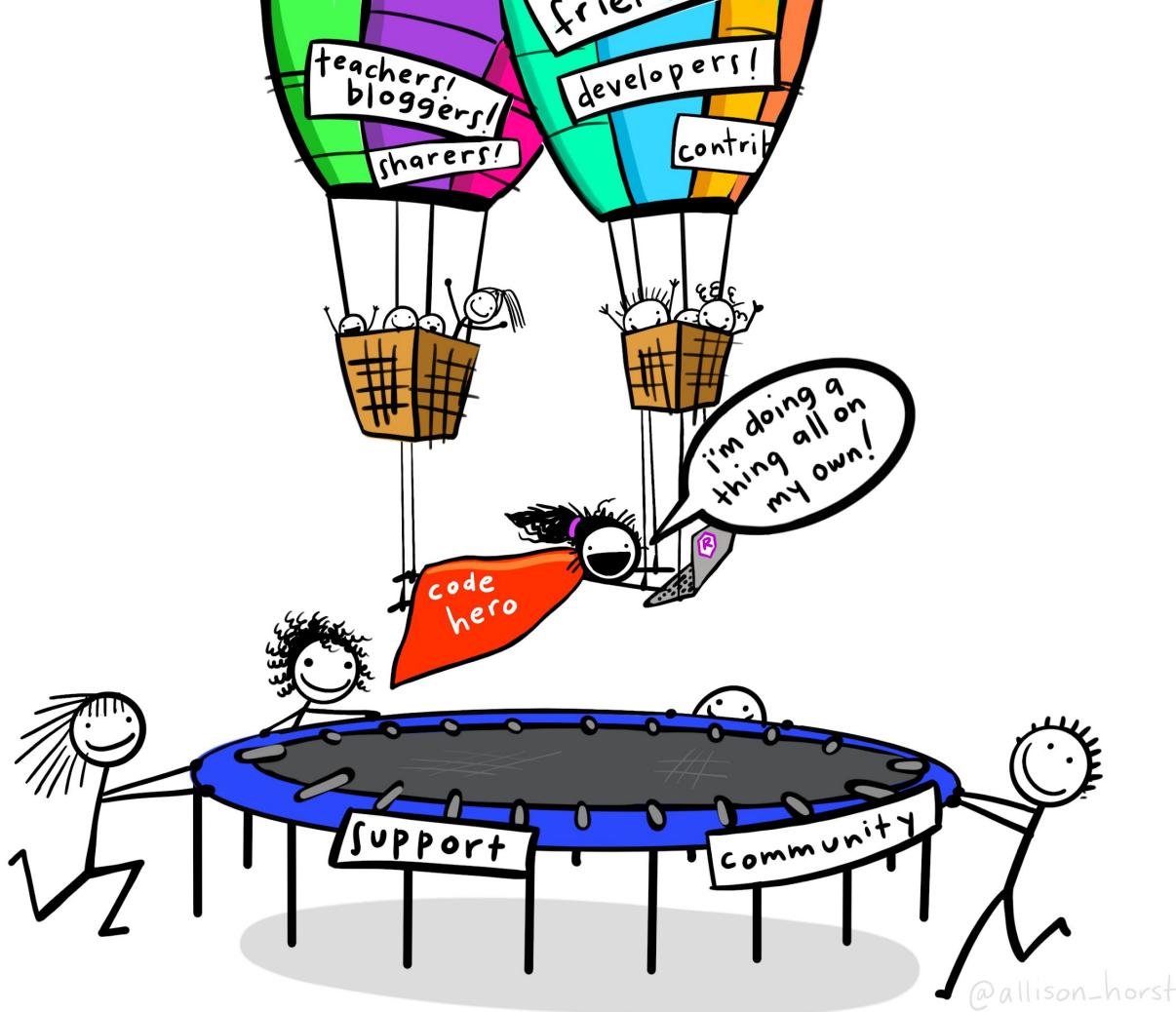
This was an introduction but there are a lot of people working on making it easier to get started in R and RStudio, begin working between RStudio and GitHub, and there is a lot of effort to improve working between R and excel.

For example, tidyverse: r-rudra.github.io/tidycells

And: nacnudus.github.io/spreadsheet-munging-strategies

As important as developing R skills yourself is enabling others around you

- This benefits you!
- Talk to your colleagues about coding and reproducible workflows.
Some conversation-starters:
 - [Our path to better science in less time using open data science tools](#) -
Lowndes et al. 2017, Nature E&E
 - [Supercharge your research: a ten-week plan for open data science](#) -
Lowndes, Horst et al. 2019, Nature
 - [Open Software Means Kinder Science](#) – Lowndes 2019 *Scientific American*
 - [Openscapes.org](#)



**THANK YOU for your participation, we look forward to seeing
you all at the conference over the next 2 days!**

Please take this short survey:

rstd.io/ws-survey