Introduction to Data Science

Stat 220

March 26 2023

Something about me

- Second year at Carleton
- Originally from Nepal
- Research in Bayesian computation and machine learning
- Avid learner and traveler

On top of Nordkette in Innsbruck, Austria

What is data science?

Data science is the application of computational and statistical techniques to gain insight into some problem in the real world

$$\begin{aligned}\text{Data Science} = &\text{ scientific inquiry} + \\ &\text{data collection} + \\ &\text{data processing} + \\ &\text{visualization} + \\ &\text{statistics} + \\ &\text{machine learning} + \\ &\text{communication}\end{aligned}$$

Data Science in a nutshell

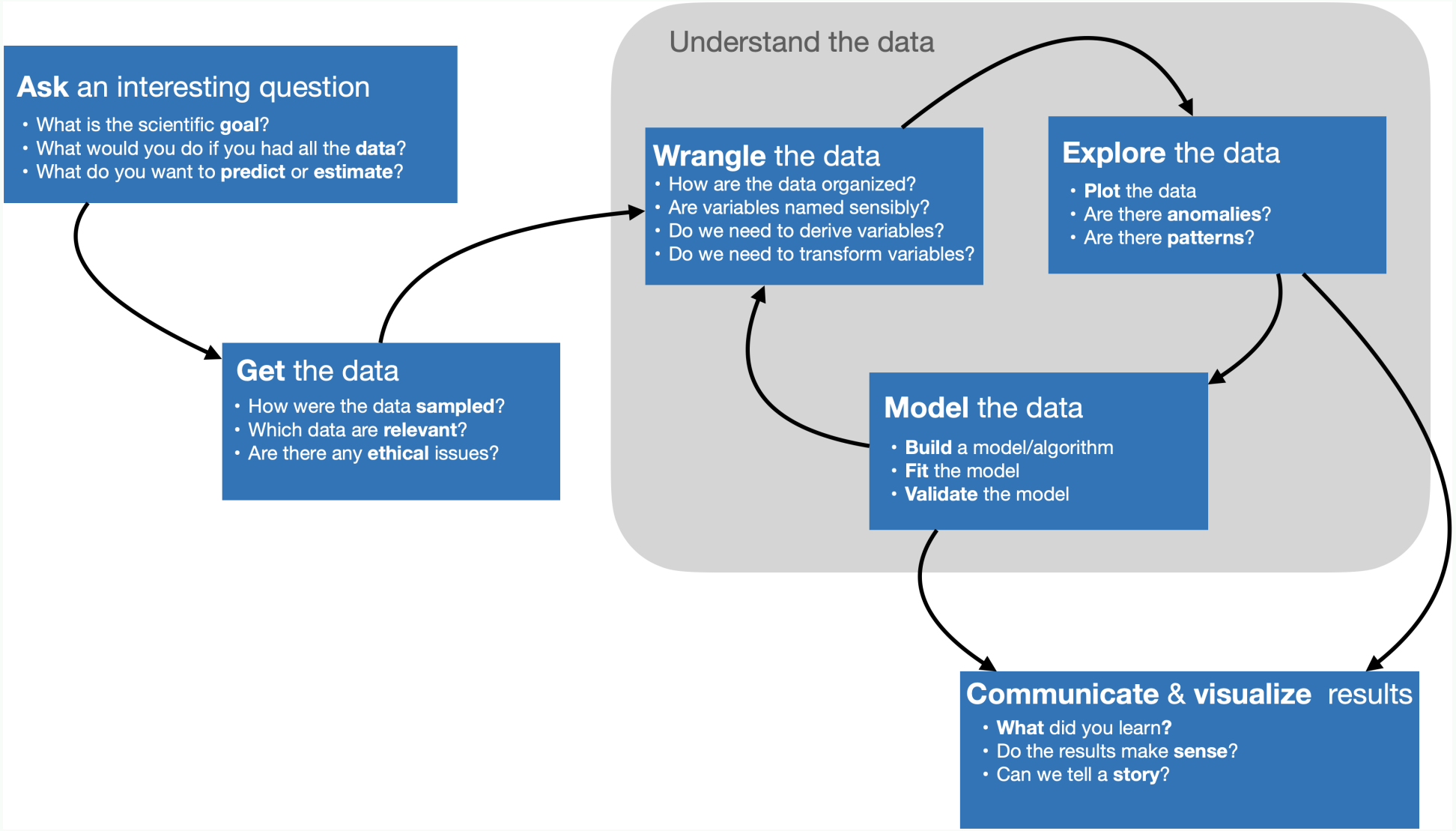


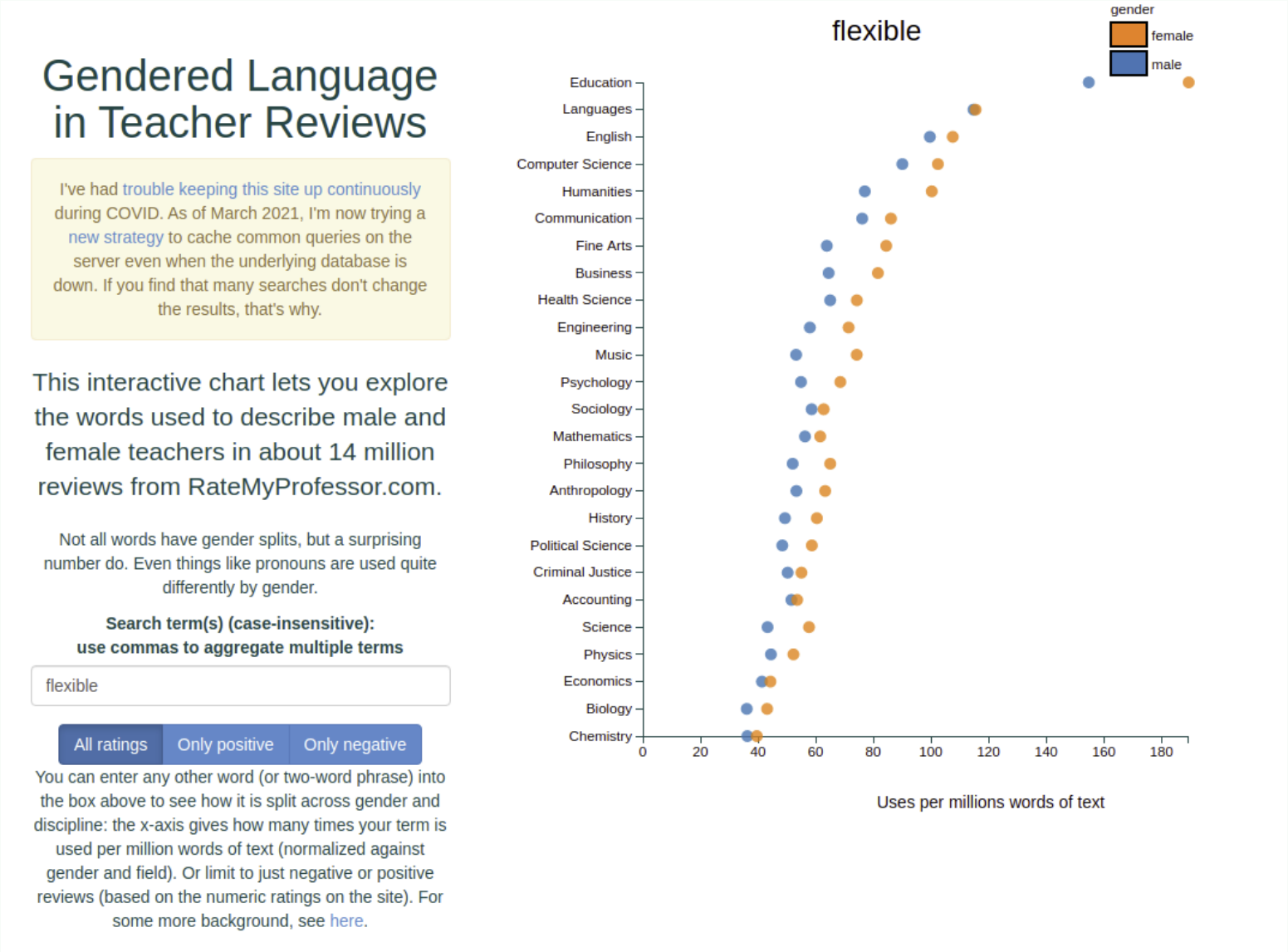
Image adapted from work of Joe Blitzstein, Hanspeter Pfister, and Hadley Wickham

Stat 220: Introduction to Data Science

Focus on the "soup to nuts" approach to problem solving

- ***data wrangling***
  - ***reshaping, cleaning, gathering***
- ***learning from data***
  - ***EDA tools***
  - ***statistical learning methods***
- ***communication***
  - ***reproducibility***
  - ***effective visualization***

Gendered language in professor reviews



Click here to go to the app

How to make friends and succeed in Data Science?

1. Actively follow along! RMarkdown (.Rmd) documents will be provided for you each class
   - use these to take notes and run code “live” in class.
2. Ask questions!
   - This is new for everyone, no question is a bad question.
3. When you don’t know if something will work, try it!
   - experimentation is key in this class.

Tell me something about yourself!

- Your name?
- Gender Pronouns?
- Why are you interested in data science?
- Your favorite media personality?

Survey Responses: One thing you are excited and nervous about?

Class Pipelines

https://stat220-spring23.netlify.app

- ***Please bookmark this page: should be checked multiple times a day***
- ***Most of the course information and schedule will be posted in moodle***
- ***Use moodle for submitting class activity and seeing grades***
- ***Use Github for homework and projects***

Necessary skills to be mastered

- programming with data
- statistical modeling
- domain knowledge
- communication

What will a typical day/week look like?

Before class:

- ***Some reading/video to introduce some topics***
- ***Work on homework/projects, come with questions***

During class:

- ***Mini lectures***
- ***Class activities***

What you need to do next . ...

- read the Rstudio for Stat220 page
- read the GitHub for Stat220 page
- read the Software for Stat220 page

R Vs Python for data science

"R is written by statisticians, for statisticians,"
Norm Matloff, Author of The Art of R Programmming, Prof. of Computer Science, UC Davis

Advantages of R over Python:

- Not so steep learning curve as Python
- R has many generic functions that are universal, e.g. `print()`, `plot()`, `summary()`
- R Comprehensive R Archive Network (CRAN) has many user-friendly packages
- R's basic `help()` and `example()` functions are much more informative than Python's counterparts

BuzzR

RStudio anatomy

https://buzzrbeeline.blog/
Emma Rand

Script file

Write code here

To run code put your cursor on the line and click the run button

Edit to correct errors

⇒ record of commands that worked

Save scripts with the **.R** extension

⇒ syntax will be highlighted

⇒ good practice

`<-` is the assignment operator

⇒ puts what is on the right in to the object on the left

⇒ Assign results if you want to use them again

Console

When you click run, code is sent to the console and executed

`>` is the prompt

⇒ do not type it

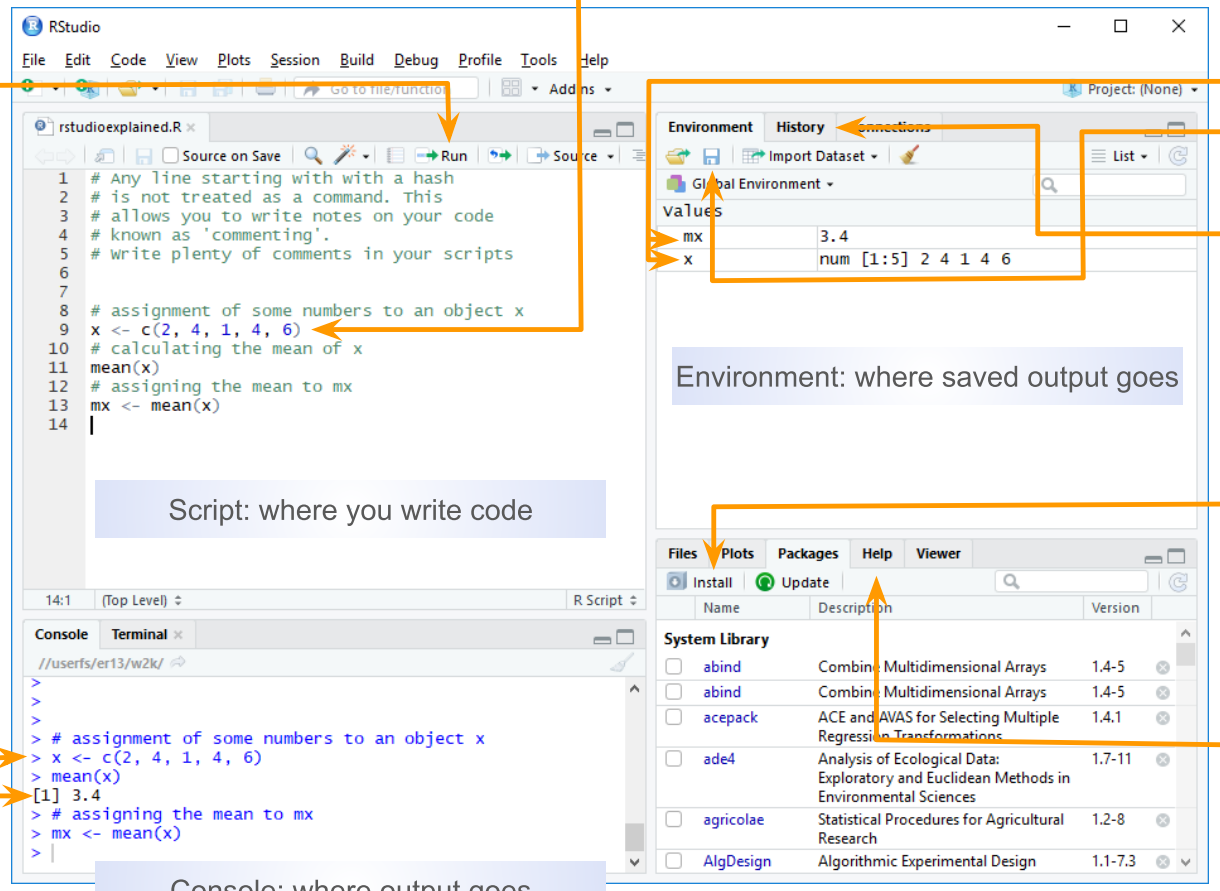
⇒ appears when R is ready for next command

Command output goes here by default

⇒ output is in a different colour

⇒ `[1]` indicates 3.4 is the first element of the output

⇒ many commands will not have output, the prompt just reappears



Environment

Name objects by assignment to use them again

All the objects you created in your session

Saving the environment saves all the objects, but not the code with a **.RData** extension

History

A history of every command you sent to the console, mistakes included.

File can be saved but usually you just need the script

Packages

Many functions come with R

A huge amount of extra functionality is available in packages

Packages can be installed by clicking the Install button

Help

Access to manual pages for all installed packages

Plots

Figure output appears here

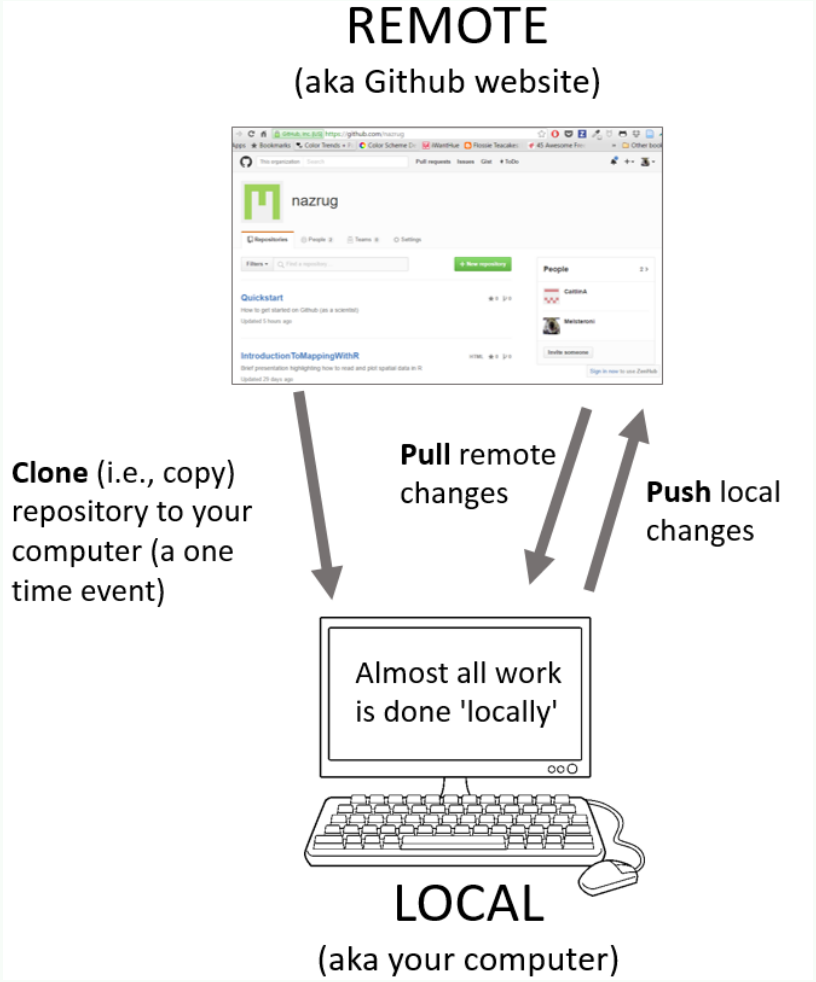
Click here for source

Using R Markdown for data science

- You will use R Markdown for all work in this class
- A Markdown (.Rmd) file contains
  - R code
  - answers, description of results, report, etc.
- The Markdown file is knit to generate an output document
  - pdf, html, word
  - presentations (html, beamer pdf)
  - dashboards, interactive graphics (html)
- Markdown is designed for reproducibility!
- The slides I produce for this class are made using R Markdown's Xaringan presentation

Version Control using Git and GitHub

- *User:* A Github account for you (e.g., deepbas).
- *Organization:* The Github account for one or more user (e.g., DataScienceFall22).
- *Repository:* A folder within the organization that includes files dedicated to a project.
- *Local Github:* Copies of Github files located your computer.
- *Remote Github:* Github files located on the https://github.com website.
- *Clone:* Process of making a local copy of a remote Github repository.
- *Pull:* Copy changes on the remote Github repository to your local Github repository.
- *Push:* Save local changes to remote Github



Git Cycle

Source: Click here

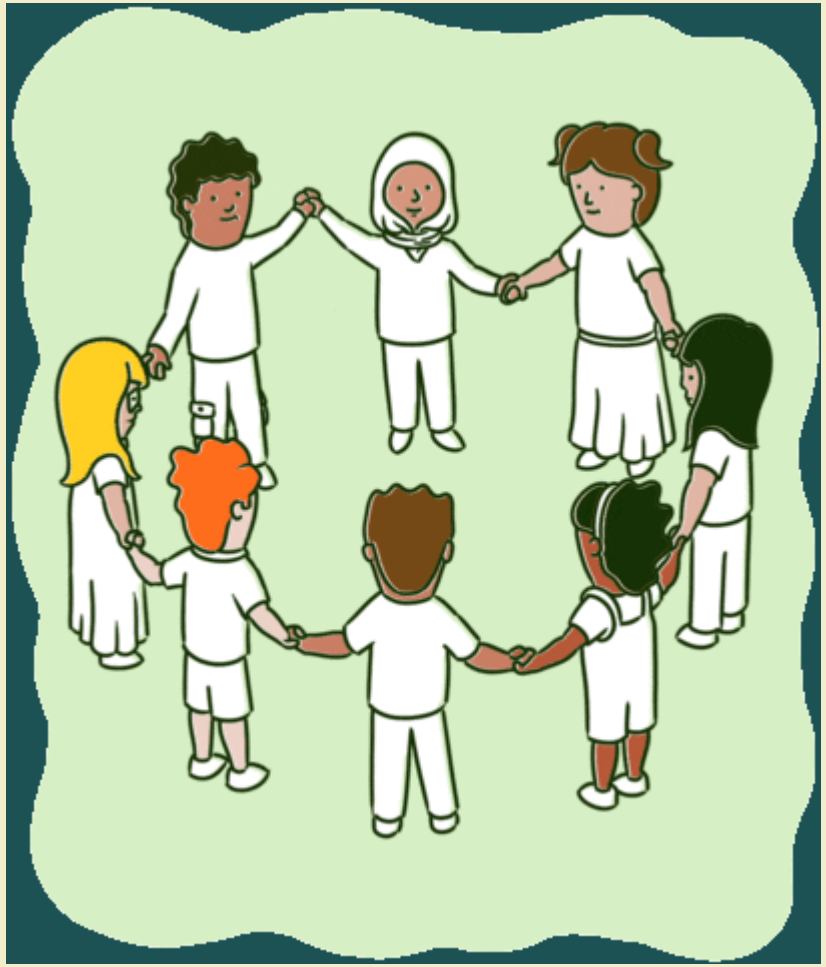
Using GitHub and Rstudio for data science

Rstudio lets you create git controlled projects

- create a GitHub repo
- make a Rstudio project using your cloned repo
- edit/create files (.rmd, .r, .csv, . . .)
- commit changes to your local computer using git
- push changes to the GitHub repo (online)
- pull changes made by others to your computer

Group Activity 1

10:00



- Work on the class-activity-1.Rmd file
- You can get the file either from Github organization repo or from moodle
- Ask me questions
- Submit your compiled .pdf file to moodle