Data Scientist's Toolbox

Course #1 from Data Science: Foundations using R

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Week 1: Data Science Fundamentals

1.1 Why Automated Videos?

- Elements for online open course
  - Tutorials
  - Slides
  - Assessments (markup language)
  - Videos
- R packages for videos: ari + didactr

    - Ari: script + slides, narrates using Amazon Polly (voice synthesis)
    - Didactr: automates steps

1.2 What is Data Science?

- Definition: using data to answer (novel) questions
- **Qualities of DS: 3V**
    - **Volume**: More data is becoming increasingly available
    - **Velocity**: Data is being generated at an astonishing rate
    - **Variety**: The data we can analyze comes in many forms
- **DS = Intersection of 3 fields**
    - **Substantive Expertise** (identify questions and data)
    - **Hacking Skills** (programming)
    - **Math & Statistics Knowledge**
- Data Scientist
    - Daryl Morey: general manager of a US basketball team, the Houston Rockets
    - Hilary Mason: FastForward labs, mining the web and understanding the way that humans interact with each other through social media
    - Nate Silver: **FiveThirtyEight**, uses statistical analysis - hard numbers - to tell compelling stories about elections, politics, sports, science, economics and lifestyle
- Example: 2009, Google analyzed commonly searched terms that had strong correlation with the CDC flu outbreaks.

1.3 What is Data?

- Definition of Data:
    - Cambridge Dictionary: Information, especially facts or numbers, collected to be examined and considered and used to help decision-making.
    - Wiki: **A set of values of qualitative定性的 or quantitative定量的 variables**
- Examples of Data Sources
    - sequencing data, population census, electronic medical records, images/videos
    - lack of tidy data sets
- Ask The Right Questions First

1.4 Getting Help

- Steps for getting help in this course
    - manuals / help files / FAQs
    - google
    - course forum, search the archives first
- Coding problems
    1. red error message: error messages, help(), forum
    2. unwanted outputs: debug, ask peers, **rubber duck debugging**
- Ask the right question
    - Forums: stackoverflow, cross validated

    - Provied detailed info:
      steps to reproduce problems, expected output, actual output, error message, version of products (R, packages, OS, etc.)
    - the more specific the question, the faster the answer
    - be ourteous
- Other resources
    - How To Ask Questions The Smart Way
    - Roger Peng's video on "Getting Help"

1.5 The Data Science Process

- DS process
    - Form Question
    - Get Data
    - Analyze Data: exploring, modeling
    - Draw Conclusion
    - Show Results

! 一些有趣的例子 !

- **Hilary: the most poisoned baby name in US history**
  By 数据科学家**Hilary Parker**
- Predicting Spatial Risk of Opioid Overdoses in Providence, RI
- **Text analysis of Trump's tweets confirms he writes only the (angrier) Android half**
- Where to Live in the US
- Sexual Health Clinics in Toronto

Week 2: R and RStudio

2.1 Installing R

- CRAN = Comprehensive R Archive Network
- Why use R?
    - Popularity
    - Free
    - Extensive functionality
    - Community: Stackoverflow, cross validated

2.2 Installing RStudio

- RStudio is a graphical user interface for R

2.3 RStudio Tour

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2.4 R Packages

- R Packages
  - Package = a collection of functions, data, and code conveniently provided in a nice complete format
  - now 14,300+ packages available
  - Packages $\in$ Library

2.4.1 Where to find packages? Repository.

- Repository = a central location where many developed packages are located and available for download
- three big repositories:
  1. **CRAN (Comprehensive R Archive Network):** R's main repository (>12,100 packages available!)
  2. **BioConductor:** A repository mainly for bioinformatic-focused packages
  3. **GitHub:** A very popular, open source repository (not R specific!)

2.4.2 How to find packages?

- CRAN Task Views
- RDocumentation
- Google: task + R package

2.4.3 How to install packages?

```
'''
CRAN Repository
'''
install.packages("ggplot2") # both single and double quotes are OK
install.packages('ggplot2')
install.packages(c("ggplot2", "devtools", "lme4")) # install multiple packages
# or Tools menu -> Install Packages...

'''
Bioconductor
'''
# from coursera
source("http://bioconductor.org/biocLite.R")
boicLite("GenomicFeatures")
# from https://bioconductor.org/install/
if (!requireNamespace("BiocManager", quietly = TRUE))
    install.packages("BiocManager")
BiocManager::install(version = "3.13")
BiocManager::install(c("GenomicFeatures", "AnnotationDbi"))

'''
GitHub
```

```
'''
# take note of both the package name and the author of the package on GitHub
install.packages("devtools")
library(devtools)
install_github("author/package")
```

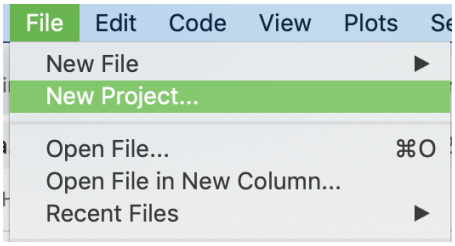
2.4.4 Other operations

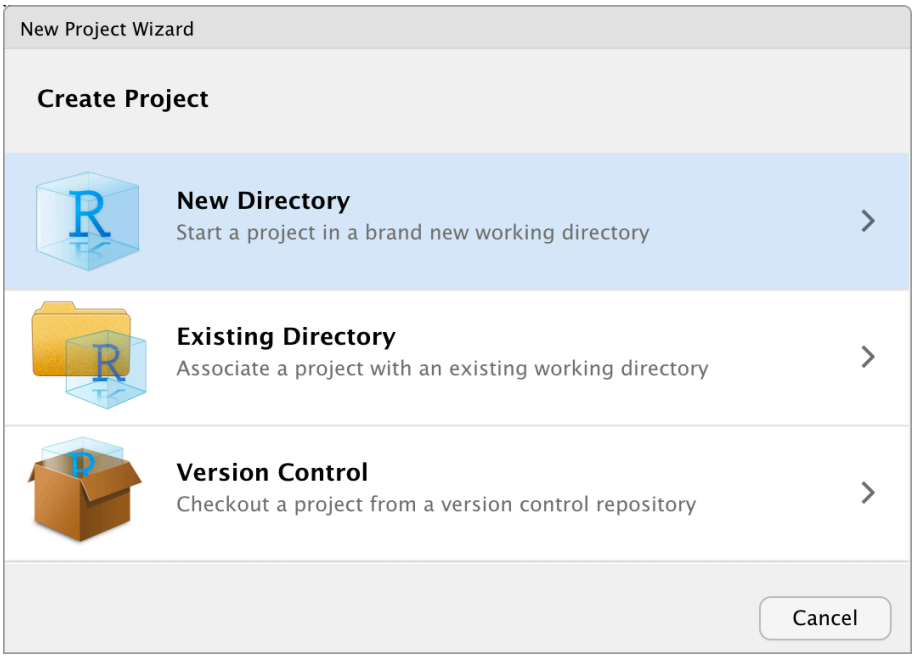
```
'''Load packages'''
library(ggplot2) # Do not put the package name in quotes!
# or "Packages" tag in RStudio


'''Unload packages'''
detacj("package:ggplot2", unload=TRUE)
# or "Packages" tag in RStudio


'''check installed packages'''
installed.packages()
library()
# or "Packages" tag in RStudio


'''update packages'''
old.packages() # check outdated packages
update.packages() # update all outdated packages
install.packages("ggplot2") # update specific package


'''uninstall packages'''
remove.package("ggplot2")
# or "Packages" tag in RStudio


'''check R version'''
# first open R/Rstudio, pay attention to the console
version
sessionInfo() # great to put on forum when posting questions


'''learn about functions in packages'''
help()
help(package = "ggplot2")
# or "Packages" tag in RStudio
browseVignettes()
browseVignettes("ggplot2")
```

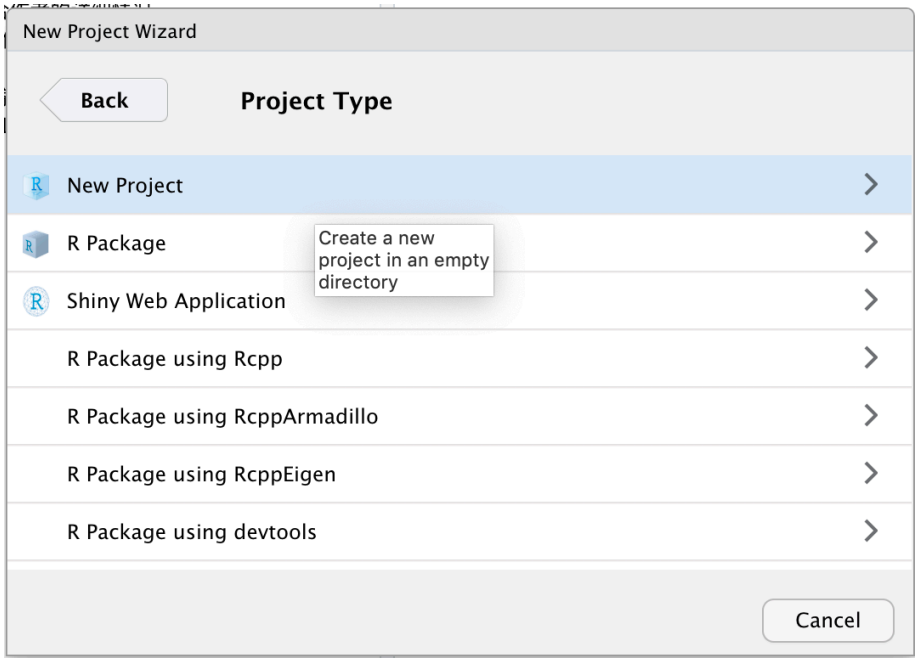
2.5 Projects in R

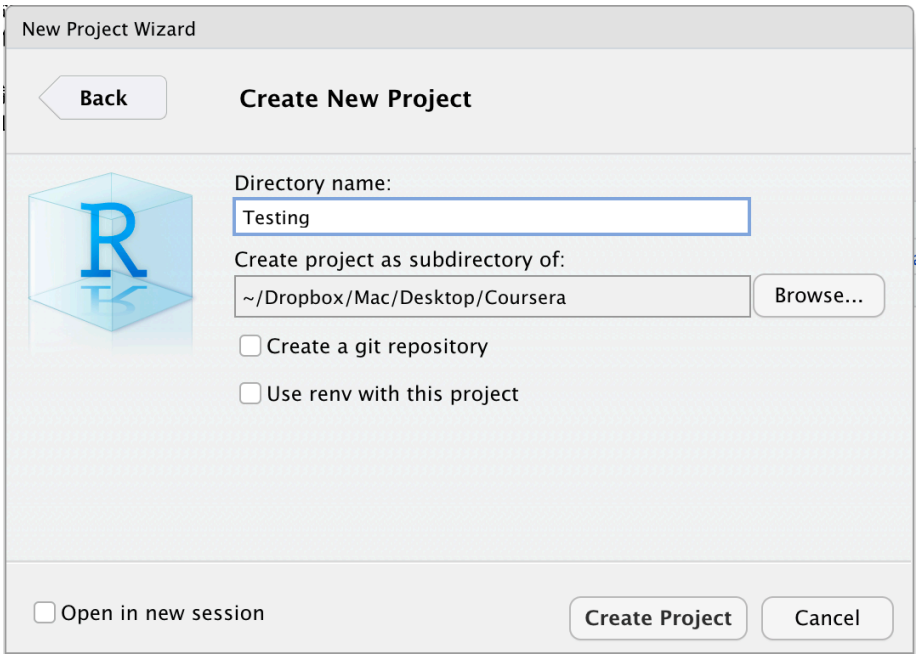
- Project in R = Creates a folder with saved environment
- Benefits of R projects
    - Easy organization
    - Easy sharing
    - Easy to start back up on a project

2.5.1 Create a new project



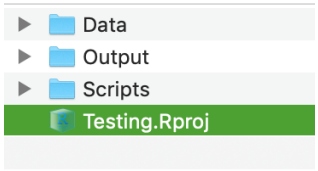


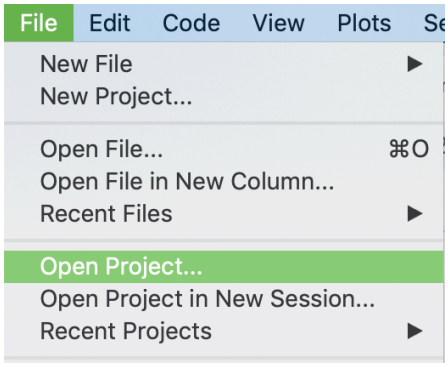


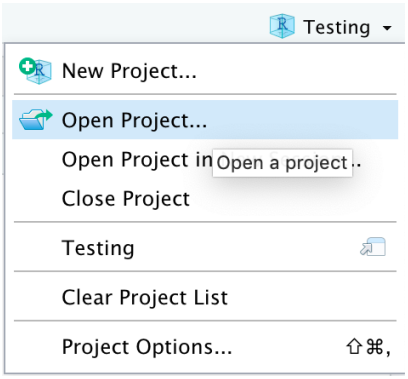


2.5.2 Open and Close a project

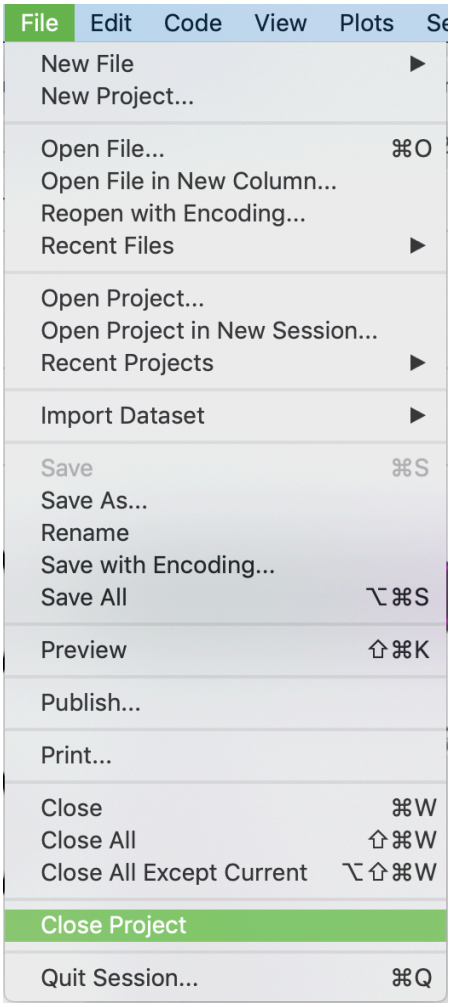
- Open * 3

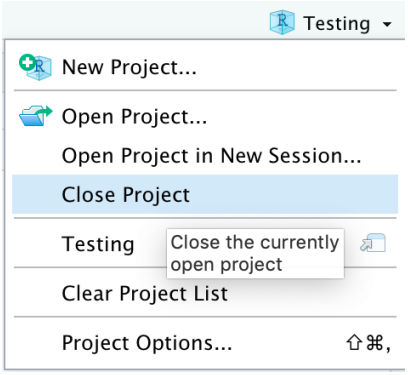



File
Edit
Code
View
Plots
New File
New Project...
Open File... ⌘O
Open File in New Column...
Recent Files
Open Project...
Open Project in New Session...
Recent Projects

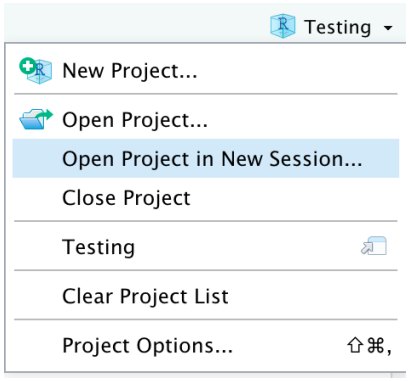

Testing
New Project...
Open Project...
Open Project in
Open a project
Close Project
Testing
Clear Project List
Project Options... ⇧⌘,

- Close * 3

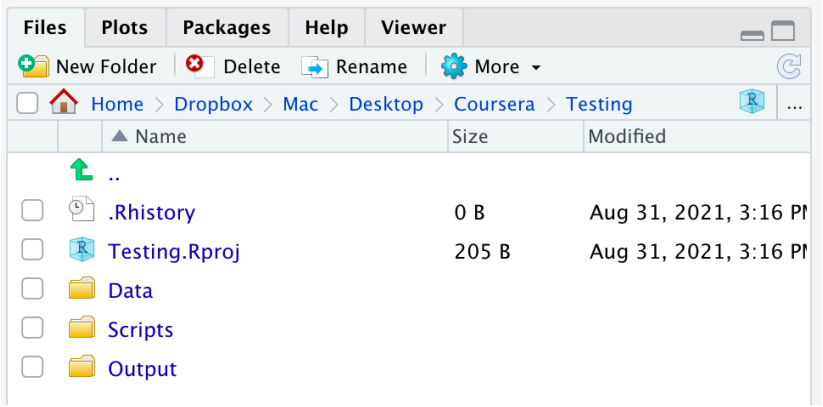

File
Edit
Code
View
Plots
New File
New Project...
Open File... ⌘O
Open File in New Column...
Reopen with Encoding...
Recent Files
Open Project...
Open Project in New Session...
Recent Projects
Import Dataset
Save ⌘S
Save As...
Rename
Save with Encoding...
Save All ⌥⌘S
Preview ⇧⌘K
Publish...
Print...
Close ⌘W
Close All ⇧⌘W
Close All Except Current ⌥⇧⌘W
Close Project
Quit Session... ⌘Q



- Switch projects / Multiple projects open at once



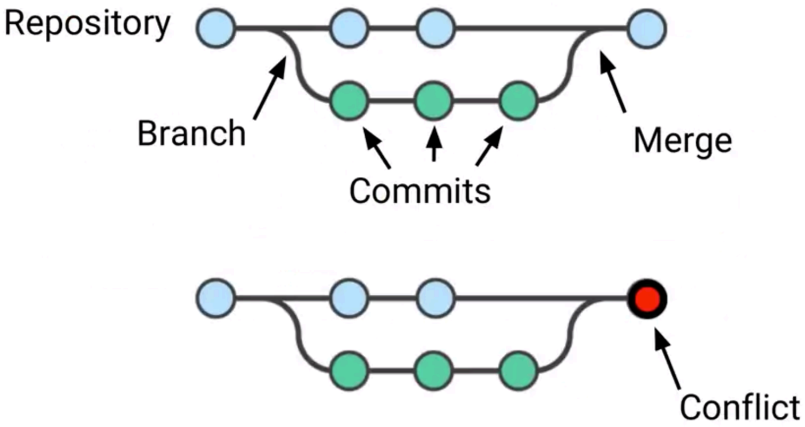
2.5.3 Setup folders in projects



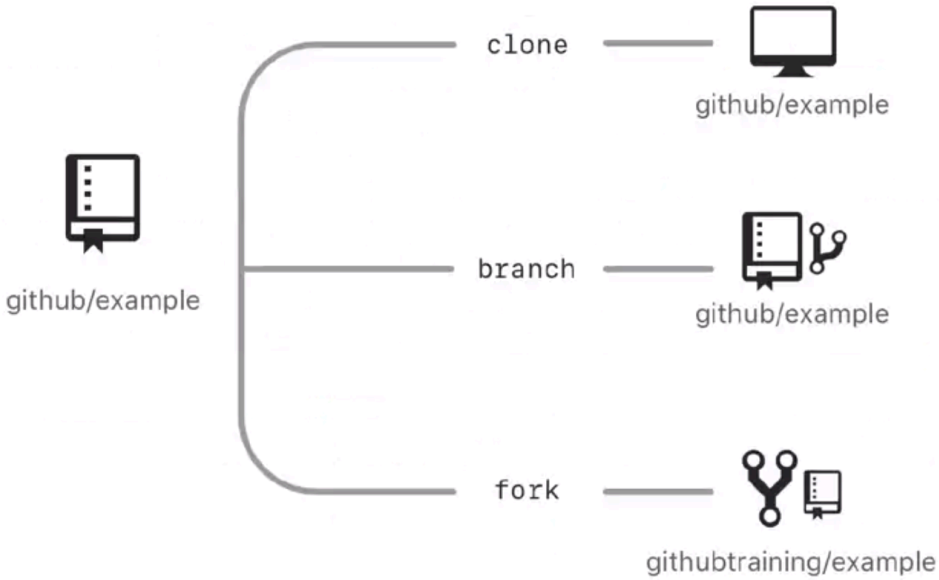
Week 3: Version Control and GitHub

3.1 Version Control

- GitHub = Online Git, Git = local version control software
  - Repository(Repo): project folder (private / public)
  - Commit: snapshot of files, changes of files and reasons for change
  - Push: update repository online
  - Pull: download repository and update local version
  - Staging: the act of preparing a file for commit



- Branch: two simultaneous copies of a same file
- Merge: incorporate independent edits into a single file
- Conflict: cannot merge the edits automatically, have to merge them manually
- Clone: copy an existing repository
- Fork: make a personal copy of a repository from others



- Best Practice
  - Purposeful, single issue commits
  - Informative commit messages
  - Pull and puch often
- Comics
  - PHD Comics
  - xkcd

3.2 GitHub and Git

3.2.1 GitHub

- Account
  - Email: tanshiyin11@yeah.net
  - Password: 4******_
- More to learn:
  - To learn more about the power of Pull Requests, we recommend reading the GitHub flow Guide. You might also visit GitHub Explore and get involved in an Open Source project.
  - Tip: Check out our other Guides, YouTube Channel and On-Demand Training for more on how to get started with GitHub.

3.2.2 Git

- 官网给出的`brew install git`运行出错，查到了下载安装包的网址

```
$ git config --global user.name "Tan Shiyin"
$ git config --global user.email tanshiyin11@yeah.net
$ git config --list
core.excludesfile=~/.gitignore
core.legacyheaders=false
core.quotepath=false
...
user.name=Tan Shiyin
user.email=tanshiyin11@yeah.net
```

3.3 Linking GitHub and RStudio

3.4 Projects Under Version Control

Week 4: R Markdown, Scientific Thinking, and Big Data