Organizing Your Research Workflow with Rstudio

A Practical Guide to Save You From Hating Yourself Later

Eli Kravitz

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Philosphy

"Always code as if the person who ends up maintaining your code is a violent psychopath who knows where you live." - CodeForTheMaintainer

- Usually this person will be you, so they will at least know where you live.

Introduction

- I will give an **opinionated** way for you to manage your research workflow in Rsudio.
  - I've learned this through trial and error... mostly error.
- Take parts of this you like, ignore parts you don't
- Many people are more qualified to talk about this
  - none of them will come here and do it for free. You're stuck with me

Scenarios (totally not based on personal experience)

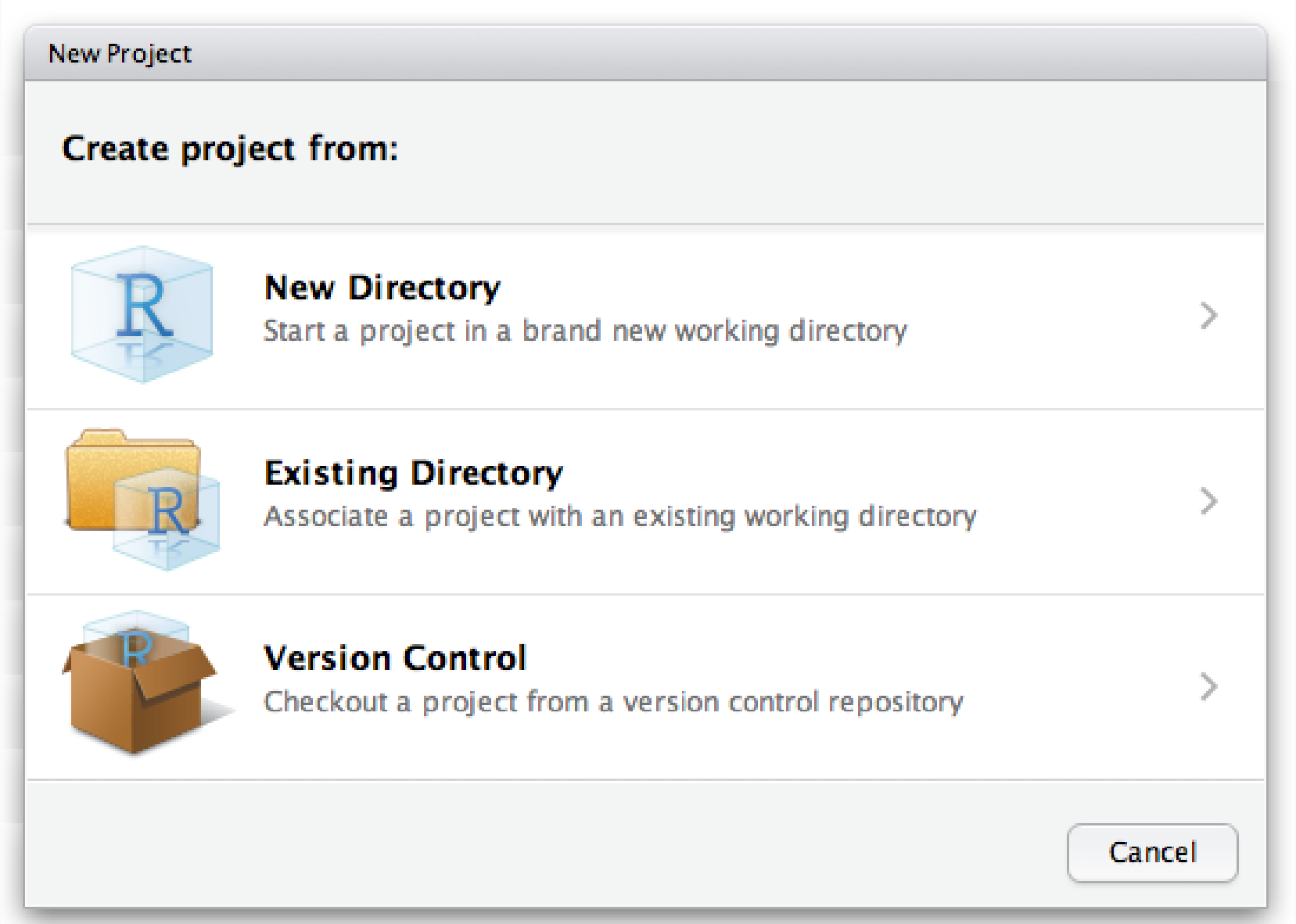
- **Scenarios 1**: You work on a project, complete 90% of it, then stop working on it for 2 years.
  - **Nothing works** on your new computer, you can't locate all the data and files you need.
- **Scenarios 2**: You have a simulation working perfectly. You make a lot of changes. **A few days later** you can't remember why you made these changes, and now **your simulation does not work correctly**.
- **Scenarios 3**: You decide to rewrite most of the paper, show it to your adviser, and they tell you it was better before.
  - You only have the old draft of the paper in PDF. You DO NOT want to retype it.

Storing Everything: Rprojects

- I organize all my research projects the same way.
  - Show folder structure
- Make the directory a Rproject.
- R projects let you:
  - Divide your work naturally
  - Store environments for every project
  - "freeze" R in a state that works (advanced, won't cover)
- Integrates nicely other things we'll cover

Making an R project

- Go to File → New Project



Making an R project

- Follow the prompts to make your project.
- You're done. Easy.
- Now do this **every time** you start a new research project.

Relative Filepaths and here()

- Does your R code start with this?

```
setwd("C:\Users\Eli\path\that\only\I\have")
mydata = read.csv(data.csv)
```

- This is **bad**. As soon as you rename or move directories, it breaks.
- What if someone else wants to use your code? What if you want to use a different computer?

Relative Filepaths and here()

- Putting your files in an Rproject already helps. The directory is to to where the .Rproj file is.

```
getwd()
```

```
## [1] "/Users/kravitze/Documents/SafeCafe/Code"
```

- Let's do better with the here package.

Relative Filepaths and here()

- Here looks for a .Rproj file and makes file paths relative

```
here()
```

```
## [1] "/Users/kravitze/Documents/SafeCafe"
```

```
here("Inner_Directory")
```

```
## [1] "/Users/kravitze/Documents/SafeCafe/Inner_Directory"
```

- Code won't need to change between computers
- Example: Load data

```
my_data = here("Data", "my_file.csv")
```

Saving Progress with Github

- Now nothing is tied to the filepaths on our computer.
- How can we **back everything up** and **make it available on multiple computers**?
- Github!

Saving Progress with Github

- Setting up Github is simple, but many steps.
  - See links at the end for instructions
- I will go over what it can do for you, and why you should work with it.

Saving Progress with Github

- Github let's you track versions on your file
- Github saves the history of your file
- Made changes to your code $\rightarrow$ you can **revert back to an earlier**. version.
- Works with .tex too!
- Show example on Github (code and .tex)

Saving Progress with Github

- Github integrates really well with Rstudio
    - Comes pre-installed on current version of Rstudio
- Point-and-click integration
- Use this and make your life easier

Make your presentations in Rstudio

- What else can we do in Rstudio? **Presentations** in Rmarkdown
- Beamer is the worst. Does anyone find this intuitive?

```
\begin{itemize}
\item
  I organize all my research projects the same way.

  \begin{itemize}
  \tightlist
  \item
    Show folder structure
  \end{itemize}
\item
  Make the directory a Rproject.
```

Make your presentations in Rstudio

- Look at how much more readable this is:

```
### Slide Title

* Bullet
  - Sub bullet

* Bullet
```

Make your presentations in Rstudio

- Compare tables
- Latex:

```
\begin{table}
\begin{center}
  \begin{tabular}{ | l | c | r }
    \hline
    1 & 2 & 3 \\ \hline
    4 & 5 & 6 \\ \hline
    7 & 8 & 9 \\
    \hline
  \end{tabular}
\end{center}
\end{table}
```

Make your presentations in Rstudio

- Rmarkdown:

```
Table Header  | Second Header | Third Header
------------- | ------------- -------------
Table Cell    | Cell 2        |  Cell 3
Cell 4        | Cell 45       |  Cell 6
```

Make your presentations in Rstudio

- You can create .tex files too. Just add to beginning of Rmarkdown

```
output:
  beamer_presentation:
    includes:
    keep_tex: yes
```

DoRNG and Reproducability

- Many of you will need to do parallel computing for your research.
- Setting seeds is tricky
- Draw two examples on board

DoRNG and Reproducability

- Fix this with DoParallel and DoRNG
- Automatically changes RNG type, feeds correct RNG to workers
- Saves the **seeds as attribute**.
    - You can recreate these results!

DoRNG and Reproducability

- So easy, no reason not to do this
- Setup:

```
library("parallel"); library("doParallel"); library("doRNG"
cl = makeForkCluster(nnodes = detectCores()-1)
registerDoParallel(cl)
registerDoRNG(seed = 123)
```

DoRNG and Reproducability

- Running reproducable parallel computing (easy too!)

```
results = foreach(i = 1:Nsim) %dorng% {
  thing_I_want_in_parallel()
}
```

- Saves seed as attribute:

```
attr(results, which = "rng")
```

```
## [[1]]
## [1]         407  -27852831  378164270 1731837655 14557995
## [7] -503406118
##
## [[2]]
## [1]          407 -1624416098 -1643081275 -1182147142  118
## [7]  2015053164
```

Resources

- I did not go over anything in detail, why anything works
- I wanted to demonstrate *why* you want to use these tools
- Next slides have resources for implementing all of this. They can teach you better than I can.

Resources

- Rprojects
- Github
- Github and Rstudio
- Here function

Resources

- Presentations in Rmarkdown
  - I really, really like this website
- Reproducable Parallel