Lecture 3

Brooke Anderson

Finding example code

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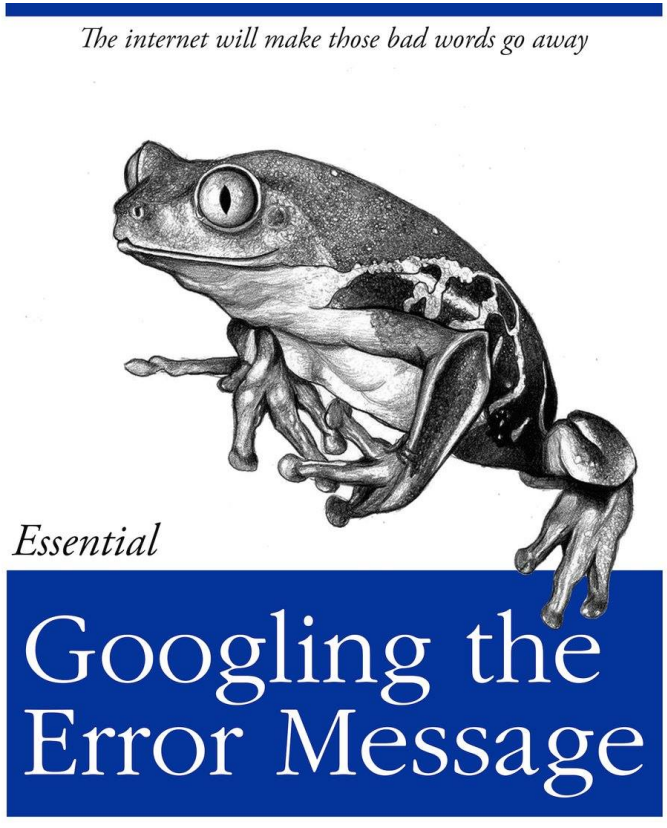

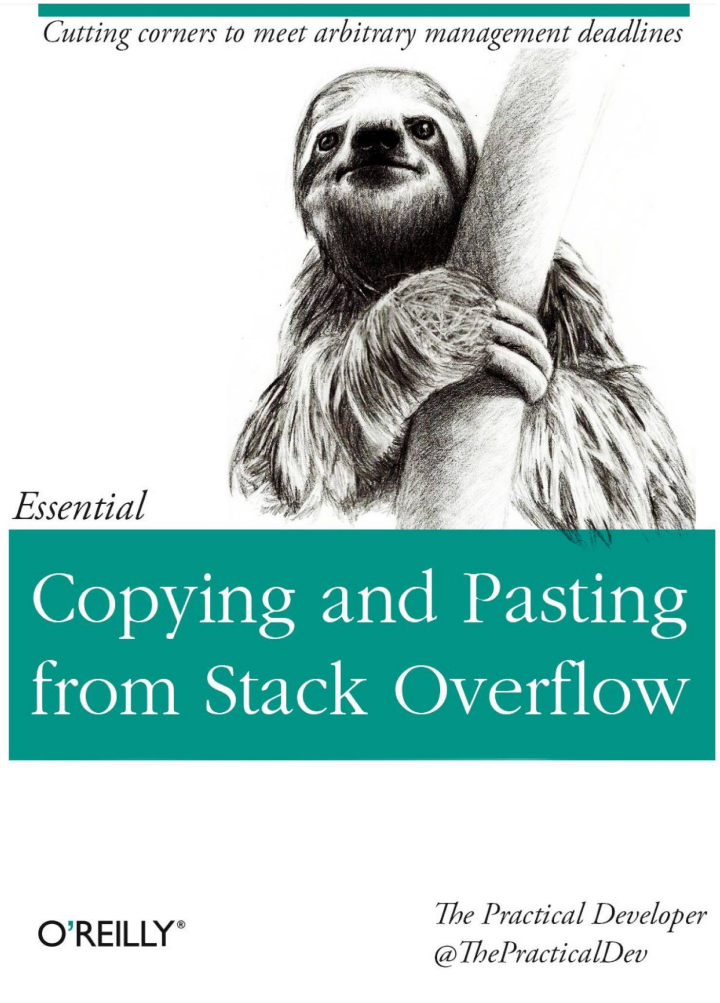

The art of Googling for code

- Learn some Google search operators
  - Quotation marks force a match to an exact term or phrase
  - A negative sign excludes a word, returning only matches that don't include that word
- If you get an error message, Google it (take out anything specific to your problem, like a filepath or object name)
- Hone your search terms
  - Continue to learn precise coding vocabulary
  - Pay attention to the language used by top responders in forums like StackOverflow
  - Refine your search terms based on what Google returns from your first search

The art of Googling for code

- Advanced Google searching, including search operators: https://support.google.com/websearch/answer/2466433?hl=en
- 21 Tips and Tricks to Master the Art of Googling as a Developer: https://www.makeuseof.com/21-tips-and-tricks-to-master-the-art-of-googling-as-a-developer/
- How to Google effectively as a developer: https://medium.com/@niamhpower/how-to-google-effectively-as-a-developer-4ebe363afe
- Googling for code solutions can be tricky—here's how to get started: https://knightlab.northwestern.edu/2014/03/13/googling-for-code-solutions-can-be-tricky-heres-how-to-get-started/

Where you may find example code

- Help forums: StackOverflow, Posit Community
- Package documentation: vignettes, helpfiles, cheatsheets
- Blog posts (especially those written with blogdown)
- AI: e.g., ChatGPT (https://openai.com/blog/chatgpt)

Cheatsheets

Work with strings with stringr : : CHEAT SHEET

The **stringr** package provides a set of internally consistent tools for working with character strings, i.e. sequences of characters surrounded by quotation marks.

Detect Matches

str_detect(string, **pattern**) Detect the presence of a pattern match in a string. *str_detect(fruit, "a")*

str_which(string, **pattern**) Find the indexes of strings that contain a pattern match. *str_which(fruit, "a")*

str_count(string, **pattern**) Count the number of matches in a string. *str_count(fruit, "a")*

str_locate(string, **pattern**) Locate the positions of pattern matches in a string. Also **str_locate_all**. *str_locate(fruit, "a")*

Subset Strings

str_sub(string, start = 1L, end = -1L) Extract substrings from a character vector. *str_sub(fruit, 1, 3); str_sub(fruit, -2)*

str_subset(string, **pattern**) Return only the strings that contain a pattern match. *str_subset(fruit, "b")*

str_extract(string, **pattern**) Return the first pattern match found in each string, as a vector. Also **str_extract_all** to return every pattern match. *str_extract(fruit, "[aeiou]")*

str_match(string, **pattern**) Return the first pattern match found in each string, as a matrix with a column for each ( ) group in pattern. Also **str_match_all**. *str_match(sentences, "(a|the) ([^]+)")*

Manage Lengths

str_length(string) The width of strings (i.e. number of code points, which generally equals the number of characters). *str_length(fruit)*

str_pad(string, width, side = c("left", "right", "both"), pad = " ") Pad strings to constant width. *str_pad(fruit, 17)*

str_trunc(string, width, side = c("right", "left", "center"), ellipsis = "...") Truncate the width of strings, replacing content with ellipsis. *str_trunc(fruit, 3)*

str_trim(string, side = c("both", "left", "right")) Trim whitespace from the start and/or end of a string. *str_trim(fruit)*

Mutate Strings

str_sub() **<-** value. Replace substrings by identifying the substrings with str_sub() and assigning into the results. *str_sub(fruit, 1, 3) <- "str"*

str_replace(string, **pattern**, replacement) Replace the first matched pattern in each string. *str_replace(fruit, "a", "-")*

str_replace_all(string, **pattern**, replacement) Replace all matched patterns in each string. *str_replace_all(fruit, "a", "-")*

str_to_lower(string, locale = "en")[1] Convert strings to lower case. *str_to_lower(sentences)*

str_to_upper(string, locale = "en")[1] Convert strings to upper case. *str_to_upper(sentences)*

str_to_title(string, locale = "en")[1] Convert strings to title case. *str_to_title(sentences)*

Join and Split

str_c(..., sep = "", collapse = NULL) Join multiple strings into a single string. *str_c(letters, LETTERS)*

str_c(..., sep = "", **collapse = NULL**) Collapse a vector of strings into a single string. *str_c(letters, collapse = "")*

str_dup(string, times) Repeat strings times times. *str_dup(fruit, times = 2)*

str_split_fixed(string, **pattern**, n) Split a vector of strings into a matrix of substrings (splitting at occurrences of a pattern match). Also **str_split** to return a list of substrings. *str_split_fixed(fruit, " ", n=2)*

glue::glue(..., .sep = "", .envir = parent.frame(), .open = "{", .close = "}") Create a string from strings and {expressions} to evaluate. *glue::glue("Pi is {pi}")*

glue::glue_data(.x, ..., .sep = "", .envir = parent.frame(), .open = "{", .close = "}") Use a data frame, list, or environment to create a string from strings and {expressions} to evaluate. *glue::glue_data(mtcars, "{rownames(mtcars)} has {hp} hp")*

Order Strings

str_order(x, decreasing = FALSE, na_last = TRUE, locale = "en", numeric = FALSE, ...)[1] Return the vector of indexes that sorts a character vector. *x[str_order(x)]*

str_sort(x, decreasing = FALSE, na_last = TRUE, locale = "en", numeric = FALSE, ...)[1] Sort a character vector. *str_sort(x)*

Helpers

```
apple
banana
pear
```

str_conv(string, encoding) Override the encoding of a string. *str_conv(fruit,"ISO-8859-1")*

```
apple
banana
pear
```

str_view(string, **pattern**, match = NA) View HTML rendering of first regex match in each string. *str_view(fruit, "[aeiou]")*

str_view_all(string, **pattern**, match = NA) View HTML rendering of all regex matches. *str_view_all(fruit, "[aeiou]")*

str_wrap(string, width = 80, indent = 0, exdent = 0) Wrap strings into nicely formatted paragraphs. *str_wrap(sentences, 20)*

[1] See bit.ly/ISO639-1 for a complete list of locales.

Finding R packages

EDUCATION

Ten simple rules for finding and selecting R packages

Caroline J. Wendt[1,2], G. Brooke Anderson[3]*

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3 Department of Environmental & Radiological Health Sciences, Colorado State University, Fort Collins, Colorado, United States of America

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https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1009884

Finding R packages

This paper includes detailed suggestions for how to find and evaluate R packages, so you can pick the best package to tackle your task. Some of the rules that are described include:

- Rule 4: Explore the availability and quality of help
- Rule 5: Quantify how established it is
- Rule 6: Seek evidence of peer acceptance and review
- Rule 8: See how it's developed

Dissecting example code

Getting example code to work

Start by trying the full piece of code.

Does the example run? If not, try these steps first:

- Make sure you have all the packages that are used in the example installed on your computer
- If there is information on the package versions from the example, compare your versions to those used in the example
- Make sure that you have the example data and it's being loaded or set up correctly in R

If it still won't run, you may have to work through it to find out

Dissecting example code

- Run through code step-by-step. Take apart pipelines if necessary
- For each step, what does input look like? What does output look like?
- Make sure you understand why each function is being called and why any arguments are being used

Dissecting example code

Assess the code as you go:

- Why does it do each step?
- If the steps are inputting and outputting the same thing (e.g., a dataframe), how does that object change from before to after the call?

Dissecting nested code

In R, you'll often find examples of code (and write them yourself) where a function call is nested within another function call.

For example, in the following example code, a `function1` call is nested inside a `function2` call:

```
function2(function1(my_data, n = 5), verbose = TRUE)
```

Dissecting nested code

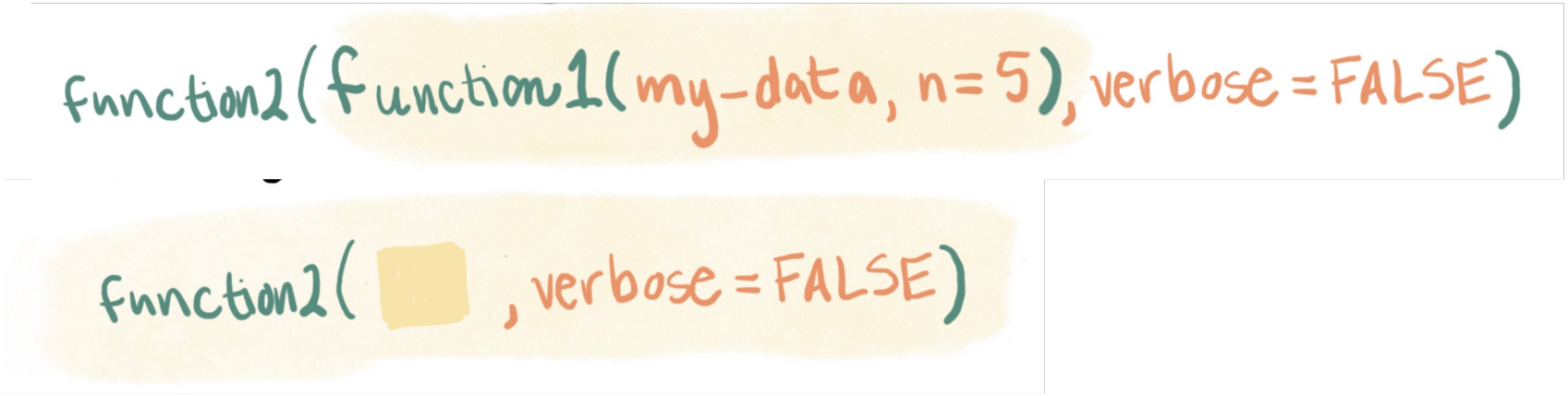
If you are trying to figure out a line of code with nested code, dissect it from the inside out.

Start by figuring out what the innermost function call is doing. For the moment, ignore everything about the other code in which it's estimated.

Dissecting nested code

Once you have figured out the innermost function call, you can think of that part of the code line as the output from that function call.

Now you can proceed to figure out the outer function call.



Dissecting piped code

Often, an example will include a series of piped functions calls.

```
my_data <- my_data %>%
  rename(better_name = `Bad Name!`) %>%
  mutate(animal_species = fct(animal_species))
```

Dissecting piped code

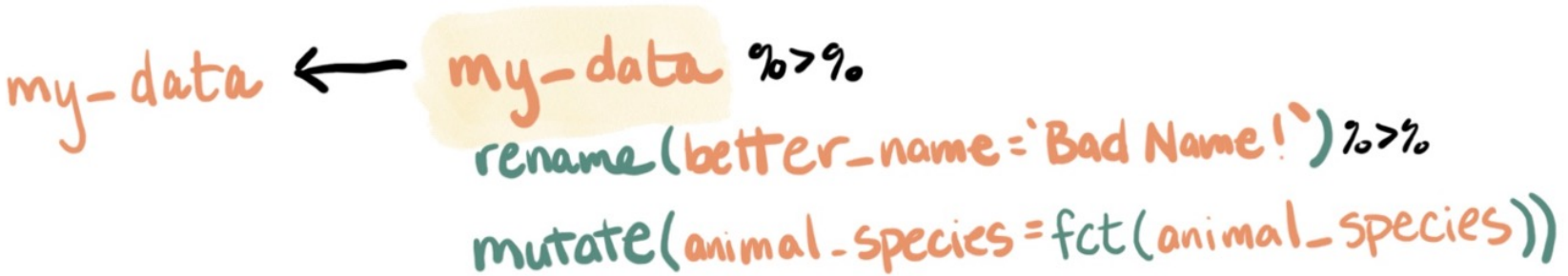
In this type of piped code, the output of one function call is sent directly as input into the next function call.

This type of code can be very clear and efficient in performing a series of simple steps. However, it's useful to have some strategies for how to dissect example code that is in a pipeline, as this isn't always as straightforward.

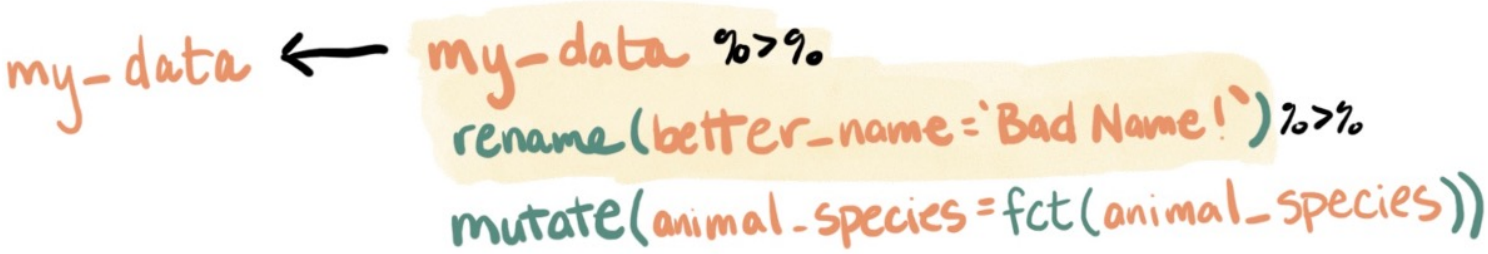
Dissecting piped code

It's a good strategy to dissect the code line by line. Figure out everything up to the first pipe before you look at the next line up to the next pipe, and so on.

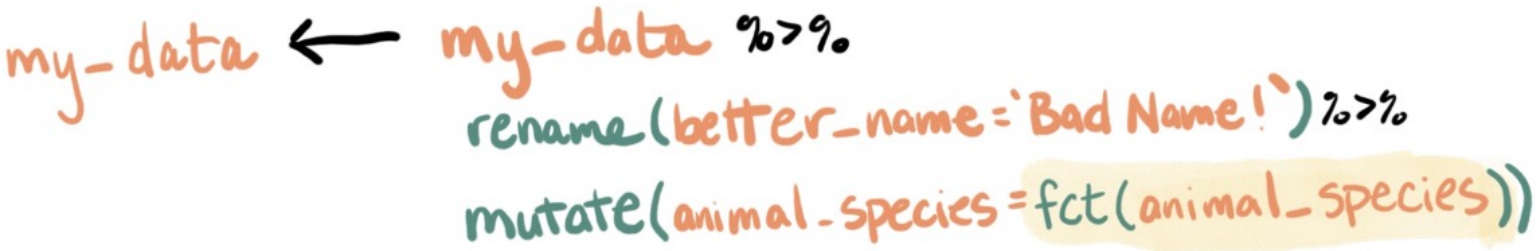
For the example code, you could start just by looking at the data input to the first pipe. In RStudio, you can do this by highlight only that dataframe name (`my_data`) and clicking the Run button (or using the keyboard shortcut for "Run"):



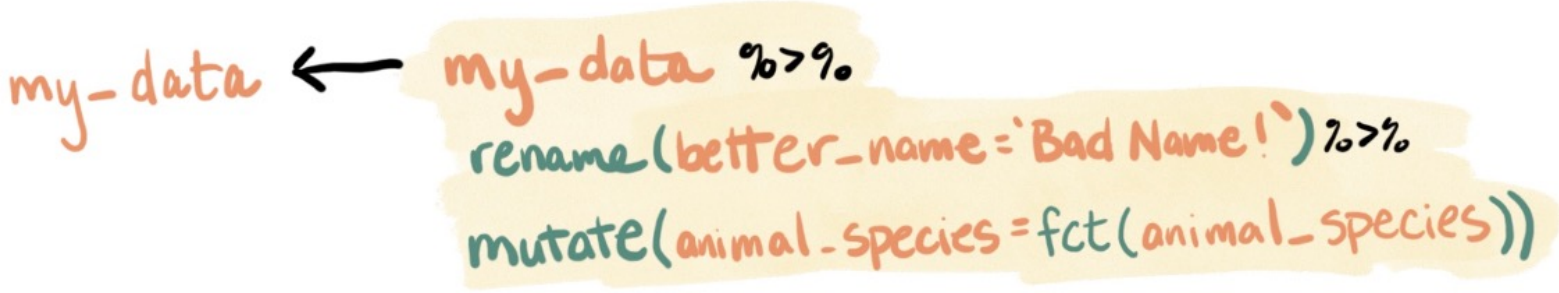
Dissecting piped code



Dissecting piped code



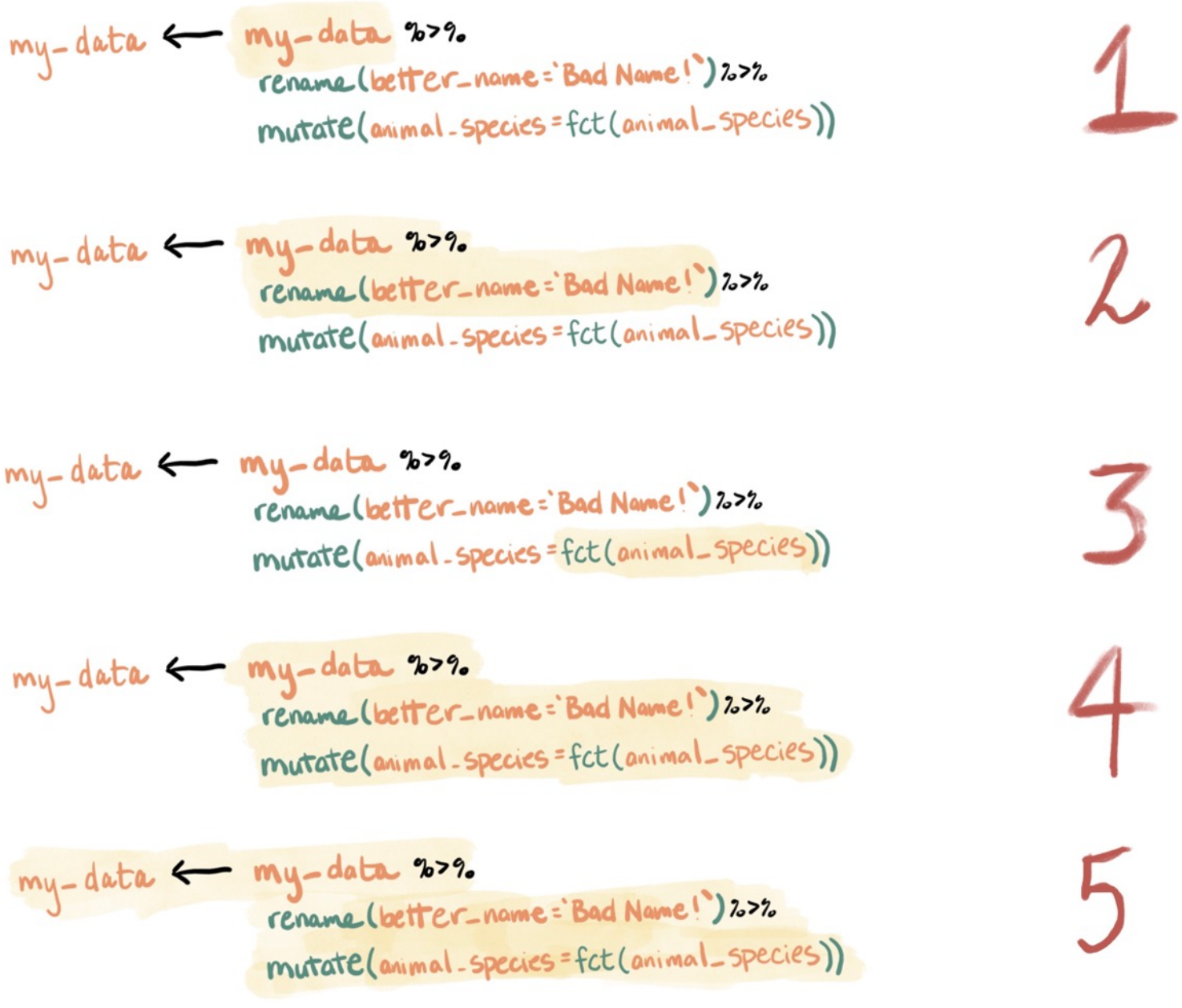
Dissecting piped code



Dissecting piped code

```
my_data <- my_data %>%
  rename(better_name = `Bad Name!`) %>%
  mutate(animal_species = fct(animal_species))
```

Full process of dissecting piped code



Can you spot the differences?

If the function call outputs a revised version of the original object, compare that object before and after the call to make sure you understand how it's changed.

```
library(stringr)
fruit <- c("apple", "bell pepper", "coconut")

fruit
```

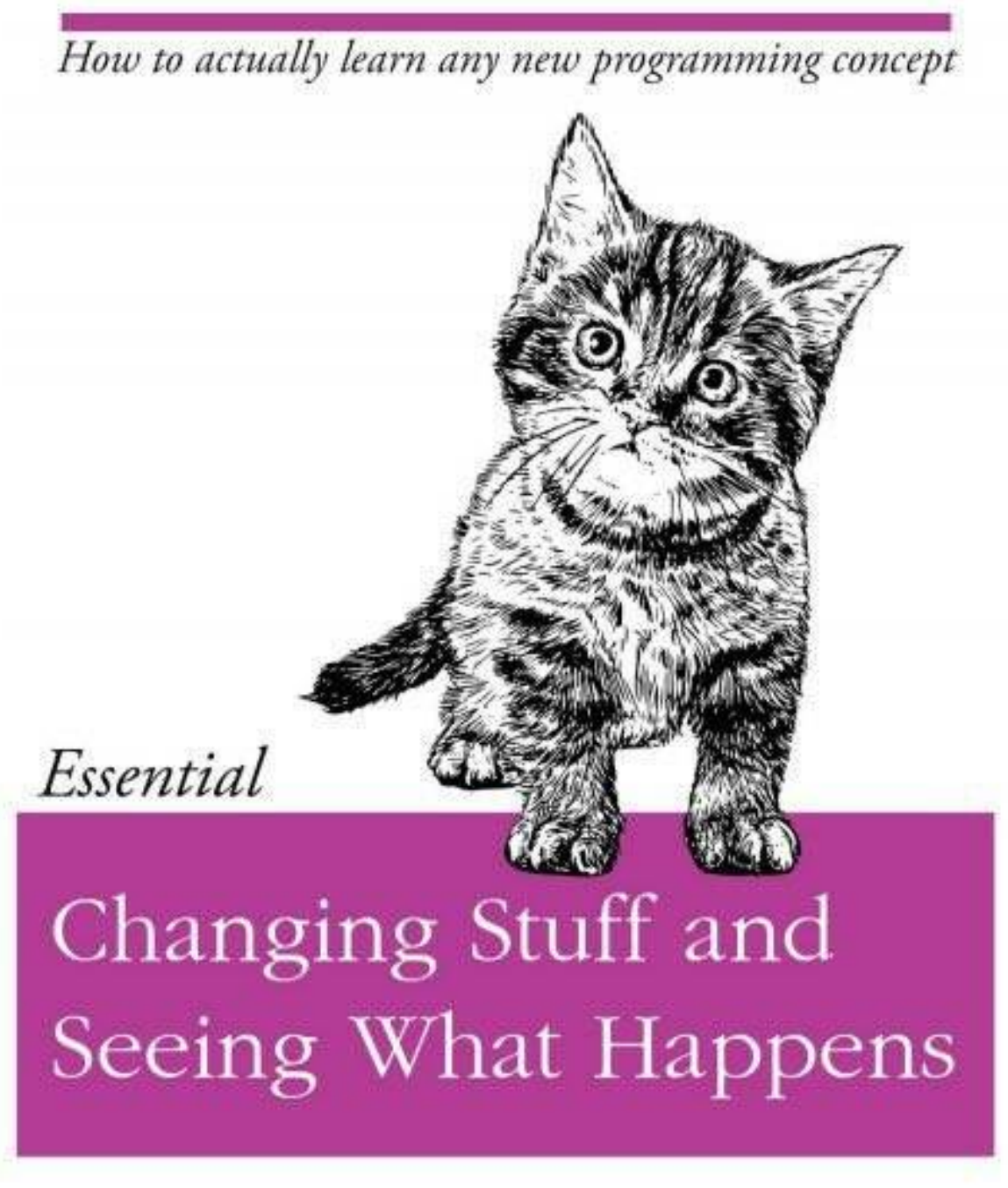
```
## [1] "apple"       "bell pepper" "coconut"
```

```
str_to_title(fruit)
```

```
## [1] "Apple"       "Bell Pepper" "Coconut"
```

Can you spot the differences?

Try changing parameters



Adapting example code

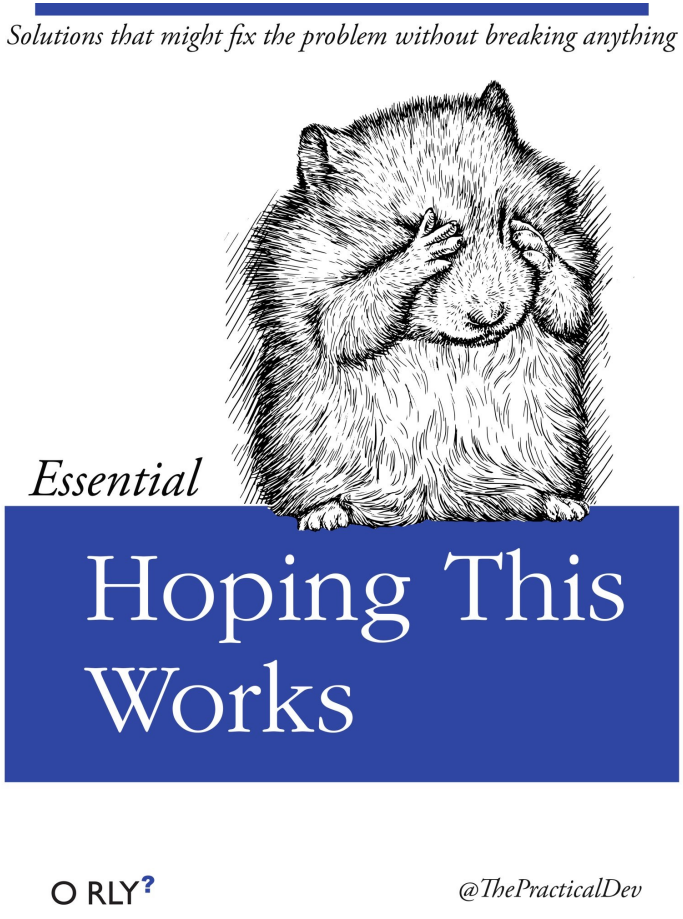
Adapting example code

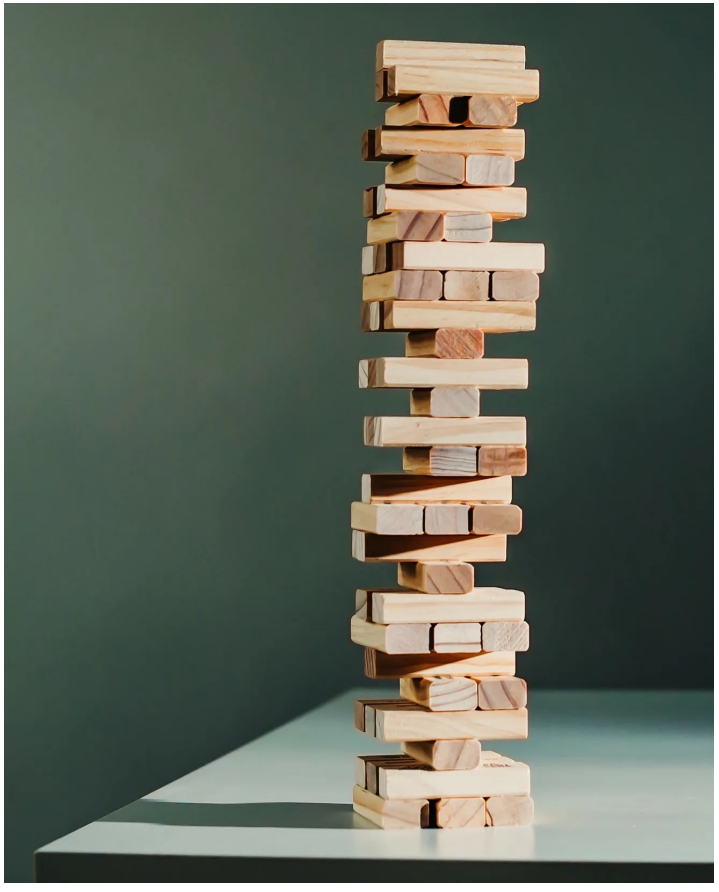
Two steps:

1. Get it to work
2. Edit it to make it more robust and reproducible

R coders often stop after the first step. This can lead to code that's hard to debug and maintain and that's likely to fail in the future.

Adapting example code





Adapting example code

Practical approaches:

- How does your data compare to the example data they use? How do you need to change it's format (or the example code) so it will work with the example code?
- Are there functions in the example code that are not in your normal set of tools? Could they be replaced with something in your usual toolset?

Adapt to your tools

We talked in the introductory lecture about how you should have a set of core tools that you know well and use often.

When you pull code from an example, it's useful to edit it to use your set of core tools if it doesn't already.

Adapt to your tools

You gain several advantages by editing code to use your own toolset:

- Bugs are less likely (especially since defaults can be different across R functions that other perform similar actions)
- If there are bugs, you will catch them more quickly
- The code will be easier for you to understand in the future

Adapt to your tools

For example, you might find an example of how to change a column in your data to a factor data class.

The example might be written using base R functions:

```
df$borough <- as.factor(df$borough)
```

If you tend to use tidyverse tools as your core toolset, you could edit the example to use those tools:

```
df <- df %>%
  mutate(borough = fct(borough))
```

What is a kluge?

From the Jargon File, a kluge is:

> *"A clever programming trick intended to solve a particular nasty case in an expedient, if not clear manner... Often involves ad-hackery..."*

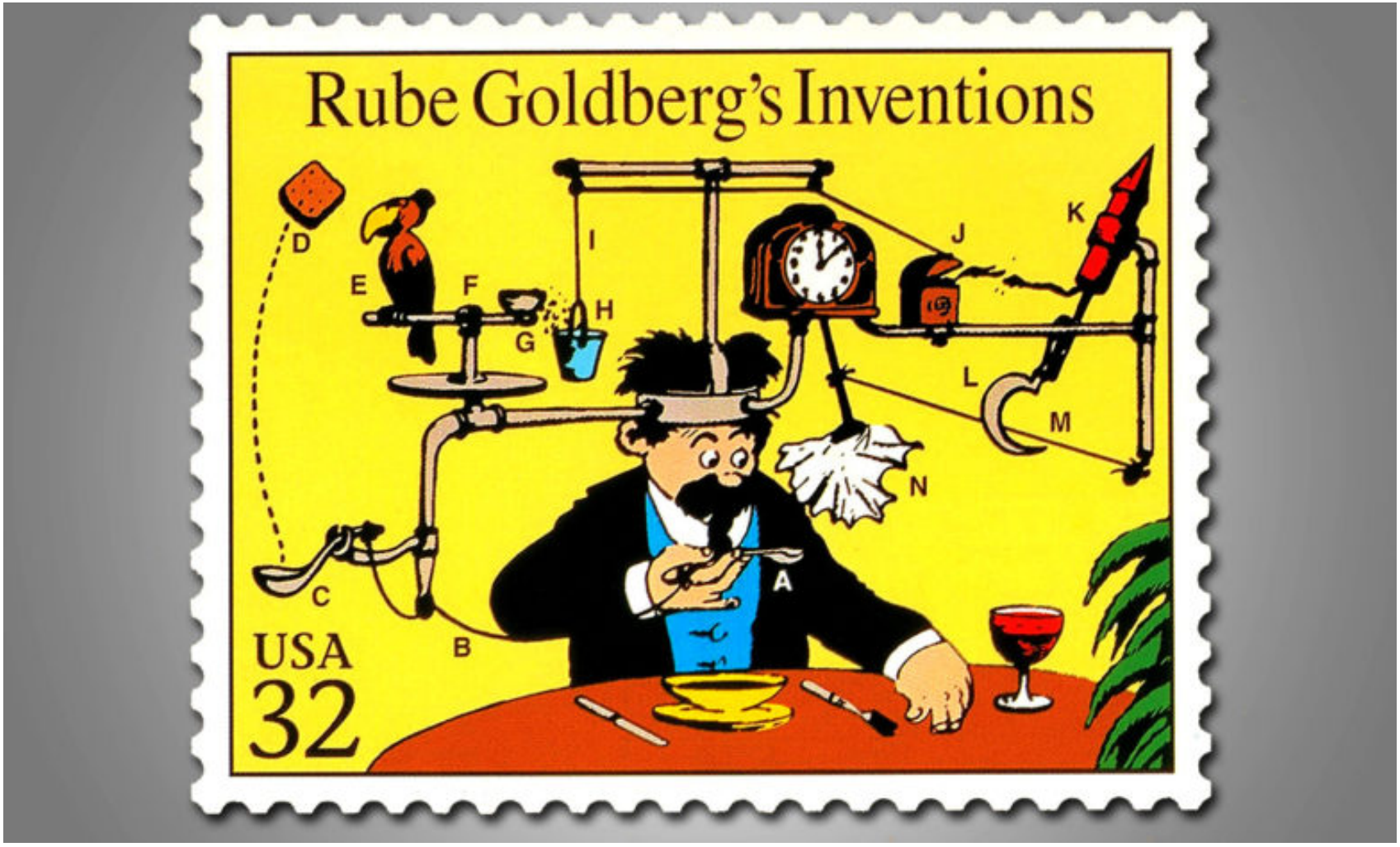
or

> *"Something that works for the wrong reason"*

http://catb.org/jargon/html/K/kluge.html

What is a kluge?

A classic example of a kluge is a Rube Goldberg machine.



What is a kluge?

Kluges can also be clever, but put together in a way that uses materials in unintended ways and that takes a while to understand.

This type of kluge is famous from the TV series MacGyver.

What is a kluge?

Other kluges are clearly going to fall apart at some point, probably in a dramatic and dangerous way.

These types of kluges are often described with, “There I Fixed It”.

Find and fix kluges

> *"The essence of proper kluge building is the designer who is so clever that he outwits himself. —"How to Design a Kluge", Datamation magazine*

You want to edit out kludges because:

- They often use longer code than you need.
- The logic of the code is not clearly linked to the logic of the problem
- They are hard to maintain, understand, and debug
- Some are strongly predisposed to fail unpredictably and dramatically

Don't prioritize **concision** or **efficiency** over **clarity**.