Welcome to the tidyverse

Week 2

AEM 2850 / 5850 : R for Business Analytics

Cornell Dyson

Spring 2025

Acknowledgements: Grant McDermott, Allison Horst

Announcements

If you are new to the class, please review canvas and course site

Prelim dates: Feb 27 and May 6 in class

Other reminders:

- Bookmark the schedule and visit often
- Submit assignments via canvas by Monday at 11:59pm going forward

Office hours update

TA office hours:

- Mondays 2:00pm - 6:00pm in Warren 370
- Fridays 2:00pm - 3:00pm in Warren 175

My office hours:

- Tuesdays 11:30 - 12:30 in Warren 464
- Thursday afternoons by appointment: aem2850.youcanbook.me

Questions before we get started?

Plan for today

Prologue

Tidyverse basics

- data frames and pipes

Data transformation with dplyr

- select
- filter
- arrange
- mutate
- summarize
- other goodies

Prologue

How we feel about the course, in a few words

- really excited!
- I feel great
- nervous but excited

Where we're from

How can we use your 85 survey responses to construct our origin story without having to read them one by one?

- **Caveat:** This is based on submissions as of 8:47 Tuesday

We can use R for this!

I won't go through details now

By the end of the course you should be able to do this kind of thing easily

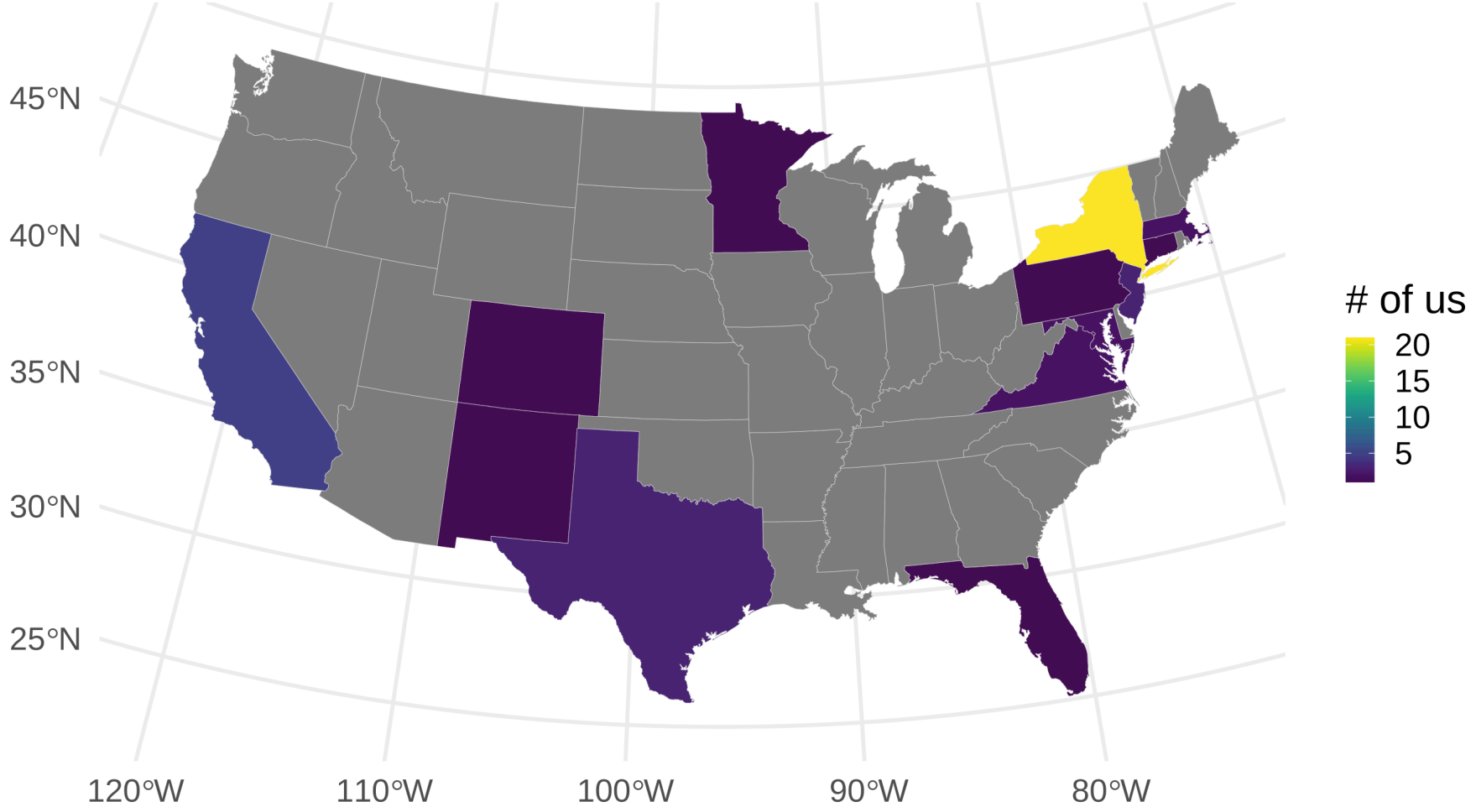
Are we all from New York?

What share of us are from the state of New York?

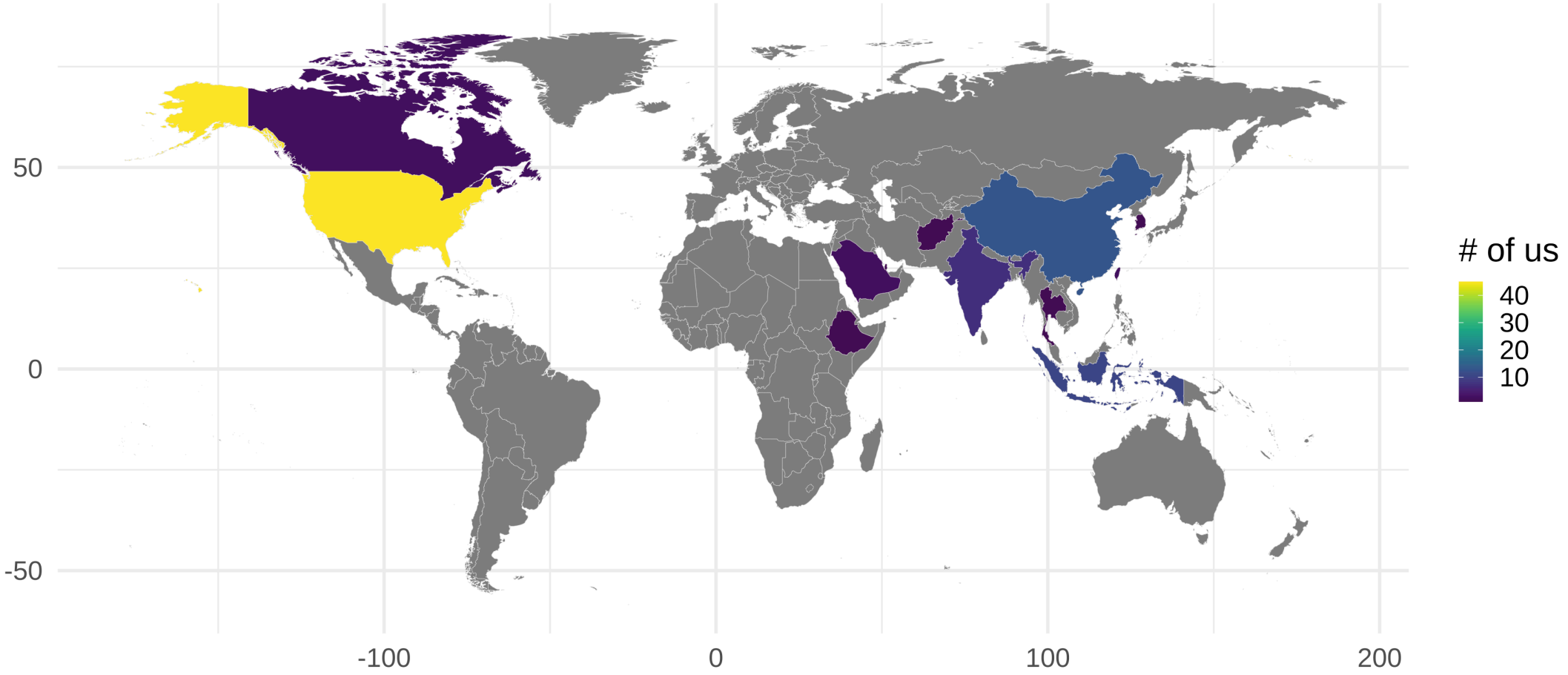
```
# step 1: do a bunch of stuff that's omitted for clarity
# step 2: show us the answer!
ny_share
```

```
## # A tibble: 1 × 2
##   origin   percent
##   <chr>      <dbl>
## 1 new york      24
```

Are we all from New York?



Are we all from the U.S.?



Tidyverse basics

R "dialects"

Last week we *briefly* introduced several R programming concepts:

- logical expressions
- assignment
- object types
- [object names, namespace conflicts]
- [indexing]

We did this using base R

- **pro:** comes in the box, close parallels to other programming languages
- **con:** can be confusing for new programmers (esp. indexing operations)

R "dialects"

This course will primarily use the tidyverse

You can think of it as a particular "dialect" of R

This dialect is similar to human language

Intuitive if you're new to programming

Not representative of all R programming

Base R and `data.table` are alternative "dialects"

Tidyverse vs. base R

Lots of debate over tidyverse vs. base R

Why we're using the tidyverse:

- Consistent philosophy and syntax
- Great documentation and community support
- For data wrangling and plotting, tidyverse is 🔥

Base R is still great, can do some things tidyverse can't

data.table is another great alternative for data wrangling

Tidyverse vs. base R

Often a correspondence between tidyverse and base R commands:

tidyverse	base
`?readr::read_csv`	`?utils::read.csv`
`?dplyr::if_else`	`?base::ifelse`
`?tibble::tibble`	`?base::data.frame`

Tidyverse alternatives typically offer extra features

Remember: There are always multiple ways to do something in R

Let's load the tidyverse meta-package

```
library(tidyverse)
```

```
## ── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──
## ✔ dplyr     1.1.4     ✔ readr     2.1.5
## ✔ forcats   1.0.0     ✔ stringr   1.5.1
## ✔ ggplot2   3.5.1     ✔ tibble    3.2.1
## ✔ lubridate 1.9.4     ✔ tidyr     1.3.1
## ✔ purrr     1.0.2
## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✖ dplyr::filter() masks stats::filter()
## ✖ dplyr::lag()    masks stats::lag()
## ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

We just loaded a bunch of packages: **ggplot2**, **dplyr**, **tidyr**, **tibble**, etc.

We also see some **namespace conflicts**

Tidyverse packages

When you install the tidyverse, you actually get a lot more packages:

```
tidyverse_packages()
```

```
##  [1] "broom"        "conflicted"    "cli"           "dbplyr"
##  [5] "dplyr"        "dtplyr"        "forcats"       "ggplot2"
##  [9] "googledrive"  "googlesheets4" "haven"         "hms"
## [13] "httr"         "jsonlite"      "lubridate"     "magrittr"
## [17] "modelr"       "pillar"        "purrr"         "ragg"
## [21] "readr"        "readxl"        "reprex"        "rlang"
## [25] "rstudioapi"   "rvest"         "stringr"       "tibble"
## [29] "tidyr"        "xml2"          "tidyverse"
```

These other packages have to be loaded separately

Tidyverse packages

Today we'll focus on **dplyr**

But first let's talk about data frames and pipes

Review: What are objects?

There are many different *types* (or *classes*) of objects

Here are some objects that we'll be working with regularly:

- vectors
- matrices
- data frames
- lists
- functions

Data frames

The most important object we'll work with is the **data frame**

You can think of it as an Excel spreadsheet

```
# Create a small data frame called "d"
d <- data.frame(x = c("a", "b", "c"), y = 7:9)
d
```

```
##   x y
## 1 a 7
## 2 b 8
## 3 c 9
```

This is essentially just a table with columns named x and y

Each row is an observation telling us the values of both x and y

Aside: tibbles are data frames with opinions

Tibbles are the default data frame in the tidyverse

Tibbles have some advantages, such as pretty printing

```
# Print the small data frame called "d"
d
```

```
##   x y
## 1 a 7
## 2 b 8
## 3 c 9
```

```
# Convert d to a tibble for pretty printing
as_tibble(d)
```

```
## # A tibble: 3 × 2
##   x         y
##   <chr> <int>
## 1 a         7
## 2 b         8
## 3 c         9
```

For this class, we'll treat "tibbles" and "data frames" as synonymous

Here is another example of a data frame

```
starwars # this data frame comes the tidyverse package dplyr
```

```
## # A tibble: 87 × 14
##    name      height  mass hair_color skin_color eye_color birth_year sex   gender
##    <chr>      <int> <dbl> <chr>      <chr>      <chr>           <dbl> <chr> <chr>
##  1 Luke Sk…    172    77 blond      fair       blue             19   male  mascu…
##  2 C-3PO       167    75 <NA>       gold       yellow          112   none  mascu…
##  3 R2-D2        96    32 <NA>       white, bl… red              33   none  mascu…
##  4 Darth V…    202   136 none       white      yellow           41.9 male  mascu…
##  5 Leia Or…    150    49 brown      light      brown            19   fema… femin…
##  6 Owen La…    178   120 brown, gr… light      blue             52   male  mascu…
##  7 Beru Wh…    165    75 brown      light      blue             47   fema… femin…
##  8 R5-D4        97    32 <NA>       white, red red              NA   none  mascu…
##  9 Biggs D…    183    84 black      light      brown            24   male  mascu…
## 10 Obi-Wan…    182    77 auburn, w… fair       blue-gray        57   male  mascu…
## # ℹ 77 more rows
## # ℹ 5 more variables: homeworld <chr>, species <chr>, films <list>,
## #   vehicles <list>, starships <list>
```

Pipes

Generic programming question: Does anyone know what pipes do?

Pipes allow us to pass information through a sequence of operations

The tidyverse loads the `magrittr` pipe, denoted `%>%`

R now has a native pipe, denoted `|>` (since R version 4.1.0)

They are identical for simple cases, but have some differences

We will use `|>` in class

Keyboard shortcut: use `Ctrl/Cmd+Shift+m` to insert the pipe (with spaces)

Pipe usage

To see why using pipes is so powerful, consider this contrived example based on what we did this morning:

1. Wake up
2. Get out of bed
3. Get dressed
4. Drink coffee
5. Go to class

A day without pipes

You could code this through a series of assignment operations:

```
me <- wake_up(me)
me <- get_out_of_bed(me)
me <- get_dressed(me)
me <- drink(me, "coffee")
me <- go(me, "class")
```

Or by putting all these operations in a single line of code:

```
me <- go(drink(get_dressed(get_out_of_bed(wake_up(me))), "coffee"), "class")
```

Neither is ideal

Pipes are the best of both worlds

We can do everything at once, in order:

```
me |>
  wake_up() |>
  get_out_of_bed() |>
  get_dressed() |>
  drink("coffee") |>
  go("class")
```

Emphasis is on verbs (e.g., `wake_up`, `get_out_of_bed`, etc.), not nouns (i.e., `me`)

Pipes: Best practices

Write linear code

Spread code out for readability: use one line per verb

Don't use pipes...

- when you need more than 10 (use intermediate objects instead)
- for multiple inputs or outputs
- for non-linear relationships

Reminder: `|>` and `%>%` can both be used, though they have some important differences for more advanced work. We will us `|>` in this class.

dplyr

What is dplyr?

What is dplyr?

The dplyr package provides a **grammar of data manipulation**

dplyr's functions are **verbs** that correspond to things we want to **do**

dplyr functions all have these things in common:

1. their first argument is a data frame
2. their other arguments describe what you want to do
3. their output is a new data frame

1 + **3** + **pipes** allow us to combine simple steps to achieve complex results

dplyr has five key verbs we will use

1. `select`: select columns (i.e., variables)
2. `filter`: subset rows based on their values
3. `arrange`: reorder rows based on their values
4. `mutate`: create new columns
5. `summarize`: collapse multiple rows into a single summary value

dplyr verbs operate on different things

- Rows:
  - `filter`: subset rows based on their values
  - `arrange`: reorder rows based on their values
- Columns:
  - `select`: select columns (i.e., variables)
  - `mutate`: create new columns
- Groups of rows:
  - `summarize`: collapse multiple rows into a single summary value

Let's study these commands together using the `starwars` data frame that comes pre-packaged with dplyr

1) dplyr::select

Recall what the `starwars` data frame looks like:

```
starwars
```

```
## # A tibble: 87 × 14
##    name      height  mass hair_color skin_color eye_color birth_year sex   gender
##    <chr>      <int> <dbl> <chr>      <chr>      <chr>           <dbl> <chr> <chr>
##  1 Luke Sk…    172    77 blond      fair       blue             19   male  mascu…
##  2 C-3PO       167    75 <NA>       gold       yellow          112   none  mascu…
##  3 R2-D2        96    32 <NA>       white, bl… red              33   none  mascu…
##  4 Darth V…    202   136 none       white      yellow           41.9 male  mascu…
##  5 Leia Or…    150    49 brown      light      brown            19   fema… femin…
##  6 Owen La…    178   120 brown, gr… light      blue             52   male  mascu…
##  7 Beru Wh…    165    75 brown      light      blue             47   fema… femin…
##  8 R5-D4        97    32 <NA>       white, red red              NA   none  mascu…
##  9 Biggs D…    183    84 black      light      brown            24   male  mascu…
## 10 Obi-Wan…    182    77 auburn, w… fair       blue-gray        57   male  mascu…
## # ℹ 77 more rows
## # ℹ 5 more variables: homeworld <chr>, species <chr>, films <list>,
## #   vehicles <list>, starships <list>
```

1) dplyr::select

`select` allows us to select columns / variables:

```
starwars |> select(name)
```

```
## # A tibble: 87 × 1
##    name
##    <chr>
##  1 Luke Skywalker
##  2 C-3PO
##  3 R2-D2
##  4 Darth Vader
##  5 Leia Organa
##  6 Owen Lars
##  7 Beru Whitesun Lars
##  8 R5-D4
##  9 Biggs Darklighter
## 10 Obi-Wan Kenobi
## # ℹ 77 more rows
```

1) dplyr::select

You can get fancy: use commas to select multiple columns, deselect a column using "-", and select consecutive columns using "first:last"

```
starwars |>
  select(name:skin_color, species, -height)
```

```
## # A tibble: 87 × 5
##    name                mass hair_color    skin_color  species
##    <chr>              <dbl> <chr>         <chr>       <chr>
##  1 Luke Skywalker        77 blond         fair        Human
##  2 C-3PO                 75 <NA>          gold        Droid
##  3 R2-D2                 32 <NA>          white, blue Droid
##  4 Darth Vader          136 none          white       Human
##  5 Leia Organa           49 brown         light       Human
##  6 Owen Lars            120 brown, grey   light       Human
##  7 Beru Whitesun Lars    75 brown         light       Human
##  8 R5-D4                 32 <NA>          white, red  Droid
##  9 Biggs Darklighter     84 black         light       Human
## 10 Obi-Wan Kenobi        77 auburn, white fair        Human
## # ℹ 77 more rows
```

1) dplyr::select

You can also rename your selected variables at the same time:

```
starwars |>
  select(alias = name, crib = homeworld)
```

```
## # A tibble: 87 × 2
##    alias              crib
##    <chr>              <chr>
##  1 Luke Skywalker     Tatooine
##  2 C-3PO              Tatooine
##  3 R2-D2              Naboo
##  4 Darth Vader        Tatooine
##  5 Leia Organa        Alderaan
##  6 Owen Lars          Tatooine
##  7 Beru Whitesun Lars Tatooine
##  8 R5-D4              Tatooine
##  9 Biggs Darklighter  Tatooine
## 10 Obi-Wan Kenobi     Stewjon
## # ℹ 77 more rows
```

1) dplyr::select

If you just want to rename columns without subsetting them, use `rename`:

```
starwars |>
  rename(alias = name, crib = homeworld)
```

```
## # A tibble: 87 × 14
##    alias    height  mass hair_color skin_color eye_color birth_year sex   gender
##    <chr>     <int> <dbl> <chr>      <chr>      <chr>           <dbl> <chr> <chr>
##  1 Luke Sk…    172    77 blond      fair       blue             19   male  mascu…
##  2 C-3PO       167    75 <NA>       gold       yellow          112   none  mascu…
##  3 R2-D2        96    32 <NA>       white, bl… red              33   none  mascu…
##  4 Darth V…    202   136 none       white      yellow           41.9 male  mascu…
##  5 Leia Or…    150    49 brown      light      brown            19   fema… femin…
##  6 Owen La…    178   120 brown, gr… light      blue             52   male  mascu…
##  7 Beru Wh…    165    75 brown      light      blue             47   fema… femin…
##  8 R5-D4        97    32 <NA>       white, red red              NA   none  mascu…
##  9 Biggs D…    183    84 black      light      brown            24   male  mascu…
## 10 Obi-Wan…    182    77 auburn, w… fair       blue-gray        57   male  mascu…
## # ℹ 77 more rows
## # ℹ 5 more variables: crib <chr>, species <chr>, films <list>, vehicles <list>,
## #   starships <list>
```

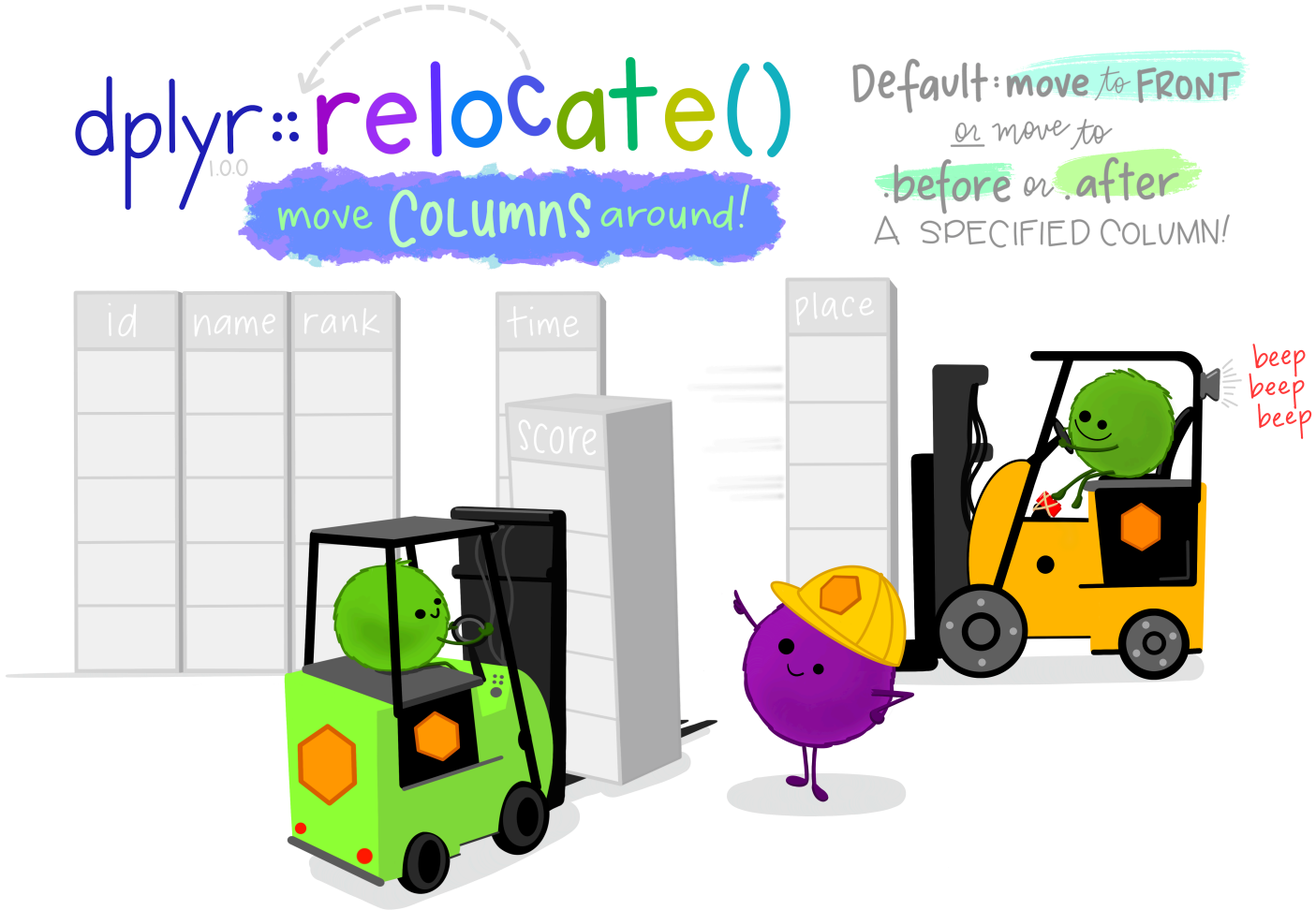
1) dplyr::~~select~~ relocate

You can also use `relocate` to move important variables to the "front" of a data frame without subsetting:

```
starwars |>
  relocate(species, homeworld) |>
  head(5)
```

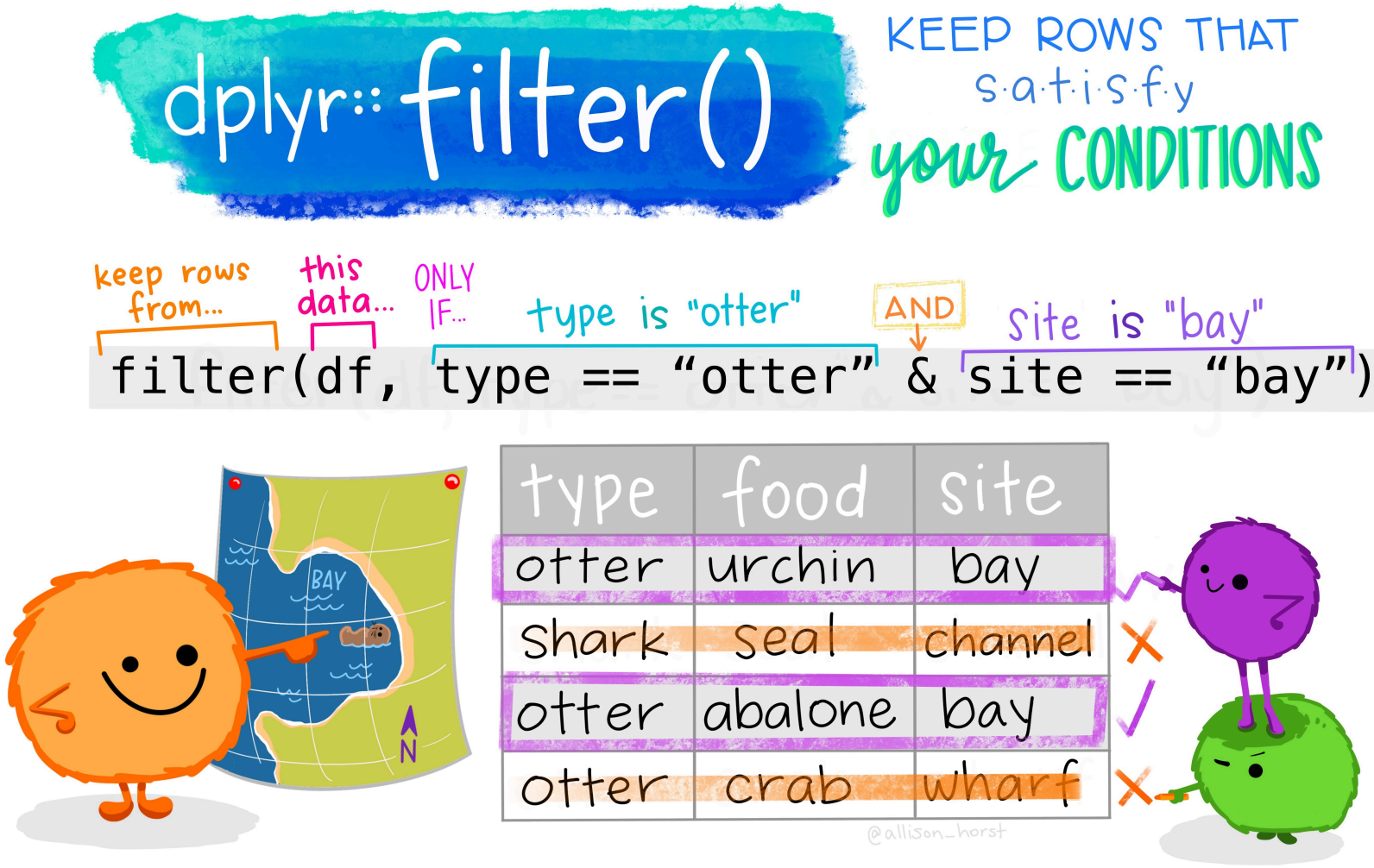
```
## # A tibble: 5 × 14
##   species homeworld name           height  mass hair_color skin_color  eye_color
##   <chr>   <chr>     <chr>           <int> <dbl> <chr>      <chr>       <chr>
## 1 Human   Tatooine  Luke Skywalker    172    77 blond      fair        blue
## 2 Droid   Tatooine  C-3PO             167    75 <NA>       gold        yellow
## 3 Droid   Naboo     R2-D2              96    32 <NA>       white, blue red
## 4 Human   Tatooine  Darth Vader       202   136 none       white       yellow
## 5 Human   Alderaan  Leia Organa       150    49 brown      light       brown
## # ℹ 6 more variables: birth_year <dbl>, sex <chr>, gender <chr>, films <list>,
## #   vehicles <list>, starships <list>
```

1) dplyr::~~select~~ relocate



Let's work through an example on Posit Cloud

2) dplyr::filter



2) dplyr::filter

`filter` allows us to focus on certain rows / observations

For example, you may only be interested in droids:

```
starwars |>
  filter(species == "Droid")
```

```
## # A tibble: 6 × 14
##   name   height  mass hair_color skin_color  eye_color birth_year sex   gender
##   <chr>   <int> <dbl> <chr>      <chr>       <chr>           <dbl> <chr> <chr>
## 1 C-3PO     167    75 <NA>       gold        yellow            112 none  masculi…
## 2 R2-D2      96    32 <NA>       white, blue red                33 none  masculi…
## 3 R5-D4      97    32 <NA>       white, red  red                NA none  masculi…
## 4 IG-88     200   140 none       metal       red                15 none  masculi…
## 5 R4-P17     96    NA none       silver, red red, blue          NA none  feminine
## 6 BB8        NA    NA none       none        black              NA none  masculi…
## # ℹ 5 more variables: homeworld <chr>, species <chr>, films <list>,
## #   vehicles <list>, starships <list>
```

2) dplyr::filter

Or perhaps you want to subset the humans that are taller than I am:

```
starwars |>
  select(name, height, species) |>
  filter(
    species == "Human",
    height >= 194
    )
```

Can you name one? *Hint: there's only one*

```
## # A tibble: 1 × 3
##   name         height species
##   <chr>         <int> <chr>
## 1 Darth Vader     202 Human
```

2) dplyr::filter

A useful `filter` use case is identifying/removing missing data using `is.na`:

```
starwars |>
  filter(is.na(height))
```

```
## # A tibble: 6 × 14
##   name      height  mass hair_color skin_color eye_color birth_year sex   gender
##   <chr>      <int> <dbl> <chr>      <chr>      <chr>           <dbl> <chr> <chr>
## 1 Arvel Cr…     NA    NA brown      fair       brown              NA male  mascu…
## 2 Finn          NA    NA black      dark       dark               NA male  mascu…
## 3 Rey           NA    NA brown      light      hazel              NA fema… femin…
## 4 Poe Dame…     NA    NA brown      light      brown              NA male  mascu…
## 5 BB8           NA    NA none       none       black              NA none  mascu…
## 6 Captain …     NA    NA none       none       unknown            NA fema… femin…
## # ℹ 5 more variables: homeworld <chr>, species <chr>, films <list>,
## #   vehicles <list>, starships <list>
```

2) dplyr::filter

How could you build on this to remove rows with missing data?

```
starwars |>
  filter(!is.na(height)) # use ! for negation
```

```
## # A tibble: 81 × 14
##    name     height  mass hair_color skin_color eye_color birth_year sex   gender
##    <chr>     <int> <dbl> <chr>      <chr>      <chr>           <dbl> <chr> <chr>
##  1 Luke Sk…    172    77 blond      fair       blue             19   male  mascu…
##  2 C-3PO       167    75 <NA>       gold       yellow          112   none  mascu…
##  3 R2-D2        96    32 <NA>       white, bl… red              33   none  mascu…
##  4 Darth V…    202   136 none       white      yellow           41.9 male  mascu…
##  5 Leia Or…    150    49 brown      light      brown            19   fema… femin…
##  6 Owen La…    178   120 brown, gr… light      blue             52   male  mascu…
##  7 Beru Wh…    165    75 brown      light      blue             47   fema… femin…
##  8 R5-D4        97    32 <NA>       white, red red              NA   none  mascu…
##  9 Biggs D…    183    84 black      light      brown            24   male  mascu…
## 10 Obi-Wan…    182    77 auburn, w… fair       blue-gray        57   male  mascu…
## # ℹ 71 more rows
## # ℹ 5 more variables: homeworld <chr>, species <chr>, films <list>,
## #   vehicles <list>, starships <list>
```

3) dplyr::arrange

`arrange` sorts the data frame based on the variable(s) you supply:

```
starwars |>
  arrange(birth_year)
```

```
## # A tibble: 87 × 14
##    name     height  mass hair_color skin_color eye_color birth_year sex   gender
##    <chr>     <int> <dbl> <chr>      <chr>      <chr>           <dbl> <chr> <chr>
##  1 Wicket …     88  20   brown      brown      brown             8   male  mascu…
##  2 IG-88       200 140   none       metal      red              15   none  mascu…
##  3 Luke Sk…    172  77   blond      fair       blue             19   male  mascu…
##  4 Leia Or…    150  49   brown      light      brown            19   fema… femin…
##  5 Wedge A…    170  77   brown      fair       hazel            21   male  mascu…
##  6 Plo Koon    188  80   none       orange     black            22   male  mascu…
##  7 Biggs D…    183  84   black      light      brown            24   male  mascu…
##  8 Han Solo    180  80   brown      fair       brown            29   male  mascu…
##  9 Lando C…    177  79   black      dark       brown            31   male  mascu…
## 10 Boba Fe…    183  78.2 black      fair       brown            31.5 male  mascu…
## # ℹ 77 more rows
## # ℹ 5 more variables: homeworld <chr>, species <chr>, films <list>,
## #   vehicles <list>, starships <list>
```

3) dplyr::arrange

We can also arrange items in descending order using `arrange(desc())`:

```
starwars |>
  arrange(desc(birth_year))
```

```
## # A tibble: 87 × 14
##    name     height  mass hair_color skin_color eye_color birth_year sex   gender
##    <chr>     <int> <dbl> <chr>      <chr>      <chr>           <dbl> <chr> <chr>
##  1 Yoda         66    17 white      green      brown             896 male  mascu…
##  2 Jabba D…    175  1358 <NA>       green-tan… orange            600 herm… mascu…
##  3 Chewbac…    228   112 brown      unknown    blue              200 male  mascu…
##  4 C-3PO       167    75 <NA>       gold       yellow            112 none  mascu…
##  5 Dooku       193    80 white      fair       brown             102 male  mascu…
##  6 Qui-Gon…    193    89 brown      fair       blue               92 male  mascu…
##  7 Ki-Adi-…    198    82 white      pale       yellow             92 male  mascu…
##  8 Finis V…    170    NA blond      fair       blue               91 male  mascu…
##  9 Palpati…    170    75 grey       pale       yellow             82 male  mascu…
## 10 Cliegg …    183    NA brown      fair       blue               82 male  mascu…
## # ℹ 77 more rows
## # ℹ 5 more variables: homeworld <chr>, species <chr>, films <list>,
## #   vehicles <list>, starships <list>
```

4) dplyr::mutate

4) dplyr::mutate

You can create new columns from scratch or by transforming existing columns:

```
starwars |>
  select(name, height) |>
  mutate(height_in_inches = height / 2.54)
```

```
## # A tibble: 87 × 3
##    name               height height_in_inches
##    <chr>               <int>             <dbl>
##  1 Luke Skywalker        172              67.7
##  2 C-3PO                 167              65.7
##  3 R2-D2                  96              37.8
##  4 Darth Vader           202              79.5
##  5 Leia Organa           150              59.1
##  6 Owen Lars             178              70.1
##  7 Beru Whitesun Lars    165              65.0
##  8 R5-D4                  97              38.2
##  9 Biggs Darklighter     183              72.0
## 10 Obi-Wan Kenobi        182              71.7
## # ℹ 77 more rows
```

4) dplyr::mutate

You can create new columns from scratch or by transforming existing columns:

```
starwars |>
  select(name, height) |>
  mutate(height_in_inches = height / 2.54) |>
  mutate(height_in_feet = height_in_inches / 12)
```

```
## # A tibble: 87 × 4
##    name               height height_in_inches height_in_feet
##    <chr>               <int>            <dbl>          <dbl>
##  1 Luke Skywalker        172             67.7           5.64
##  2 C-3PO                 167             65.7           5.48
##  3 R2-D2                  96             37.8           3.15
##  4 Darth Vader           202             79.5           6.63
##  5 Leia Organa           150             59.1           4.92
##  6 Owen Lars             178             70.1           5.84
##  7 Beru Whitesun Lars    165             65.0           5.41
##  8 R5-D4                  97             38.2           3.18
##  9 Biggs Darklighter     183             72.0           6.00
## 10 Obi-Wan Kenobi        182             71.7           5.97
## # ℹ 77 more rows
```

4) dplyr::mutate

`mutate` creates variables in order, so we can chain them together in a single call:

```
starwars |>
  select(name, height) |>
  mutate(height_in_inches = height / 2.54, # separate with a comma
         height_in_feet = height_in_inches / 12)
```

```
## # A tibble: 87 × 4
##    name               height height_in_inches height_in_feet
##    <chr>               <int>             <dbl>          <dbl>
##  1 Luke Skywalker        172              67.7           5.64
##  2 C-3PO                 167              65.7           5.48
##  3 R2-D2                  96              37.8           3.15
##  4 Darth Vader           202              79.5           6.63
##  5 Leia Organa           150              59.1           4.92
##  6 Owen Lars             178              70.1           5.84
##  7 Beru Whitesun Lars    165              65.0           5.41
##  8 R5-D4                  97              38.2           3.18
##  9 Biggs Darklighter     183              72.0           6.00
## 10 Obi-Wan Kenobi        182              71.7           5.97
## # ℹ 77 more rows
```

4) dplyr::mutate

Boolean, logical, and conditional operators all work well with `mutate`

For example:

```
starwars |>
  filter(name=="Luke Skywalker" | name=="Anakin Skywalker") |>
  select(name, height) |>
  mutate(tall = height > 180)
```

How many rows do you think this will return? How many columns?

```
## # A tibble: 2 × 3
##   name             height tall
##   <chr>             <int> <lgl>
## 1 Luke Skywalker      172 FALSE
## 2 Anakin Skywalker    188 TRUE
```

5) dplyr::summarize

Often we want to get summary statistics or *collapse* our data

`summarize` provides an easy way to do this

Example: "What are the mininum, maximum, and average prices of `diamonds`?"

```
diamonds |>
  summarize(
    min = min(price),       # calculate the min price
    max = max(price),       # calculate the max price
    average = mean(price)   # calculate the mean price
  )
```

```
## # A tibble: 1 × 3
##     min   max average
##   <int> <int>   <dbl>
## 1   326 18823   3933.
```

5) dplyr::summarize

Including `na.rm = TRUE` keeps NAs from propagating to the end result:

```
# probably not what we want
starwars |>
  summarize(mh = mean(height))
```

```
## # A tibble: 1 × 1
##      mh
##   <dbl>
## 1    NA
```

```
# better
starwars |>
  summarize(mh = mean(height, na.rm = TRUE))
```

```
## # A tibble: 1 × 1
##      mh
##   <dbl>
## 1  175.
```

Is this a feature or a bug?

It depends on the context!

Bonus: dplyr::group_by

`summarize` is particularly useful in combination with `group_by`:

```
starwars |>
  group_by(species) |> # for each species
  summarize(mean_height = mean(height, na.rm = TRUE)) # calculate the mean height
```

```
## # A tibble: 38 × 2
##    species   mean_height
##    <chr>           <dbl>
##  1 Aleena           79
##  2 Besalisk        198
##  3 Cerean          198
##  4 Chagrian        196
##  5 Clawdite        168
##  6 Droid           131.
##  7 Dug             112
##  8 Ewok             88
##  9 Geonosian       183
## 10 Gungan          209.
## # ℹ 28 more rows
```

Bonus: dplyr::ungroup

Groups are persistent (sort of), `ungroup` removes them

Let's work through an example on Posit Cloud

(the remaining slides contain other dplyr goodies for your reference)

Other dplyr goodies: distinct

`distinct` to isolate unique observations:

```
starwars |> distinct(species)
```

```
## # A tibble: 38 × 1
##    species
##    <chr>
##  1 Human
##  2 Droid
##  3 Wookiee
##  4 Rodian
##  5 Hutt
##  6 <NA>
##  7 Yoda's species
##  8 Trandoshan
##  9 Mon Calamari
## 10 Ewok
## # ℹ 28 more rows
```

Other dplyr goodies: count

`count` to get the number of observations:

```
starwars |>
  count(species)
```

```
## # A tibble: 38 × 2
##    species        n
##    <chr>      <int>
##  1 Aleena         1
##  2 Besalisk       1
##  3 Cerean         1
##  4 Chagrian       1
##  5 Clawdite       1
##  6 Droid          6
##  7 Dug            1
##  8 Ewok           1
##  9 Geonosian      1
## 10 Gungan         3
## # ℹ 28 more rows
```

```
starwars |>
  group_by(species) |> summarize(num = n())
```

```
## # A tibble: 38 × 2
##    species      num
##    <chr>      <int>
##  1 Aleena         1
##  2 Besalisk       1
##  3 Cerean         1
##  4 Chagrian       1
##  5 Clawdite       1
##  6 Droid          6
##  7 Dug            1
##  8 Ewok           1
##  9 Geonosian      1
## 10 Gungan         3
## # ℹ 28 more rows
```

Other dplyr goodies: window functions

Window functions make it easy to get leads and lags, percentiles, cumulative sums, etc.

- These are often used in conjunction with grouped mutates
- See `vignette("window-functions")`

The final set of dplyr "goodies" worth mentioning are the family of join operations, but we'll come back to those later