

How to repeat yourself with purrr

Jennifer Bryan, Posit

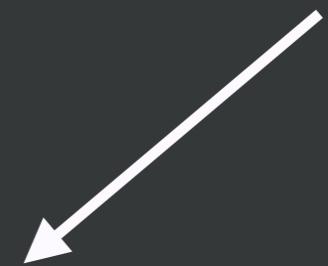
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installs purrr,
among other things

```
install.packages("tidyverse")
```

```
install.packages("repurrrsive")
```



https://github.com/jennybc/2023_raukr-purrr-pkg-dev

rstd.io/jenny-live-code

1. What is the harm with copy/paste and repetitive code?

2. What should I do instead?

- write functions (earlier this week)
- use formal tools to iterate the R way

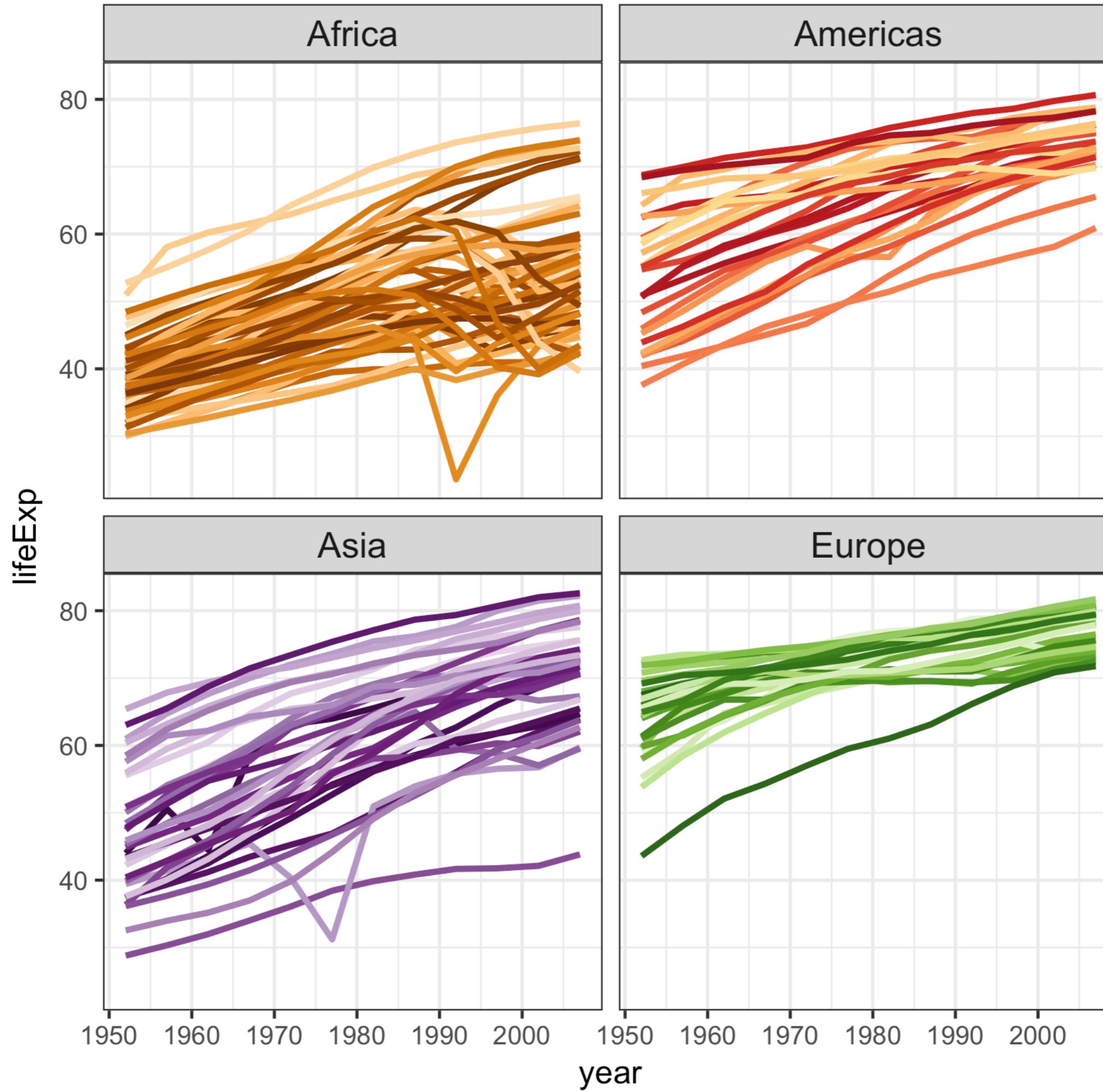
3. Hands-on practice with the purrr package for iteration

```
library(gapminder)
library(tidyverse)
```

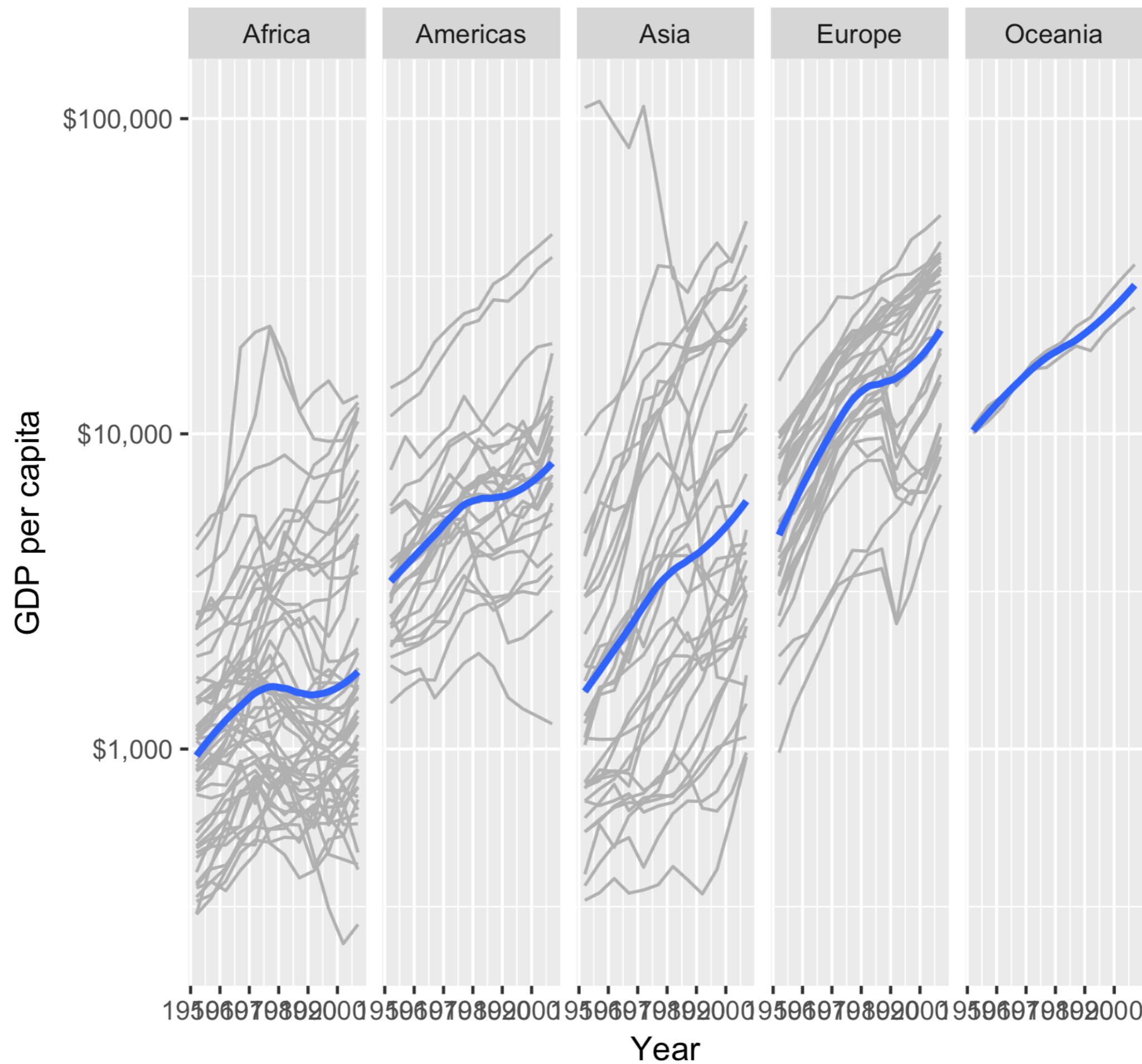
```
gapminder
```

```
#> # A tibble: 1,704 x 6
#>   country      continent    year  lifeExp     pop gdpPercap
#>   <fct>        <fct>    <int>   <dbl>   <int>     <dbl>
#> 1 Afghanistan Asia      1952    28.8  8425333    779.
#> 2 Afghanistan Asia      1957    30.3  9240934    821.
#> 3 Afghanistan Asia      1962    32.0 10267083    853.
#> 4 Afghanistan Asia      1967    34.0 11537966    836.
#> 5 Afghanistan Asia      1972    36.1 13079460    740.
#> 6 Afghanistan Asia      1977    38.4 14880372    786.
#> 7 Afghanistan Asia      1982    39.9 12881816    978.
#> 8 Afghanistan Asia      1987    40.8 13867957    852.
#> 9 Afghanistan Asia      1992    41.7 16317921    649.
#> 10 Afghanistan Asia     1997    41.8 22227415    635.
#> # ... with 1,694 more rows
```

```
gapminder %>%
  count(continent)
#> # A tibble: 5 × 2
#>   continent     n
#>   <fct>     <int>
#> 1 Africa      624
#> 2 Americas    300
#> 3 Asia        396
#> 4 Europe      360
#> 5 Oceania     24
```



GDP per capita on Five Continents



```
africa <- gapminder[gapminder$continent == "Africa", ]  
africa_mm <- max(africa$lifeExp) - min(africa$lifeExp)
```

```
americas <- gapminder[gapminder$continent == "Americas", ]  
americas_mm <- max(americas$lifeExp) - min(americas$lifeExp)
```

```
asia <- gapminder[gapminder$continent == "Asia", ]  
asia_mm <- max(asia$lifeExp) - min(asia$lifeExp)
```

```
europe <- gapminder[gapminder$continent == "Europe", ]  
europe_mm <- max(europe$lifeExp) - min(europe$lifeExp)
```

```
oceania <- gapminder[gapminder$continent == "Oceania", ]  
oceania_mm <- max(europe$lifeExp) - min(oceania$lifeExp)
```

```
cbind(  
  continent = c("Africa", "Asias", "Europe", "Oceania"),  
  max_minus_min = c(africa_mm, americas_mm, asia_mm,  
                    europe_mm, oceania_mm))
```

What am I trying to do?

Have I even done it?*

* Can you find my mistakes?

How would *you* compute this?

for each continent

max life exp - min life exp

put result in a data frame

Here's how I would do it.

```
gapminder %>%
  group_by(continent) %>%
  summarize(max_minus_min = max(lifeExp) - min(lifeExp))
#> # A tibble: 5 x 2
#>   continent max_minus_min
#>   <fct>           <dbl>
#> 1 Africa            52.8
#> 2 Americas          43.1
#> 3 Asia              53.8
#> 4 Europe             38.2
#> 5 Oceania           12.1
```

Conclusion: there are many ways to write a for loop in R!

sidebar on pipes

magrittr: %>%

base: |>

<https://www.tidyverse.org/blog/2023/04/base-vs-magrittr-pipe/>

```
filter(gapminder, country == "Canada")
gapminder |>
  filter (country == "Canada")
```

```
mean(x)
x |> mean()
```

```
whatever(arg1, arg2, arg3, ...)
```

```
arg1 |>
```

```
whatever(arg2, arg3, ...)
```

New example: making strings

```
child <- c("Reed", "Wesley", "Eli", "Toby")
age    <- c(    14,          12,          12,          1)

s <- rep_len("", length(child))
for (i in seq_along(s)) {
  s[i] <- paste(child[i], "is", age[i], "years old")
}
s
#> [1] "Reed is 14 years old"      "Wesley is 12 years old"
#> [3] "Eli is 12 years old"       "Toby is 1 years old"
```

Here's how I would do it.

```
child <- c("Reed", "Wesley", "Eli", "Toby")
age   <- c(    14,        12,        12,        1)

paste(child, "is", age, "years old")
#> [1] "Reed is 14 years old"      "Wesley is 12 years old"
#> [3] "Eli is 12 years old"      "Toby is 1 years old"

glue:::glue("{child} is {age} years old")
#> Reed is 14 years old
#> Wesley is 12 years old
#> Eli is 12 years old
#> Toby is 1 years old
```

Conclusion: maybe someone already wrote that for loop for you!

But what if you really do
need to iterate?



<https://purrr.tidyverse.org>



Part of the tidyverse

A "core" package in the tidyverse meta-package

```
install.packages("tidyverse") # <-- install purrr + much more
```

```
install.packages("purrr")      # <-- installs only purrr
```

```
library(tidyverse) # <-- loads purrr + much more
```

```
library(purrr)      # <-- loads only purrr
```

purrr is an alternative to "apply" functions

`purrr::map()` ≈ `base::lapply()`

The screenshot shows a dark-themed website for the `purrr` package. At the top, there's a navigation bar with links: "purrr tutorial", "Lessons and examples", "More resources", "Talks", and "About". Below the navigation bar is a sidebar containing a list of topics:

- Why not base?
- Why purrr?
- Why not plyr?
- `lapply()` vs. `purrr::map()`
- `sapply()` vs. `\(\cdot\)`
- `vapply()` vs. `map_*`
- `\(\cdot\)` vs. `map_df()`
- `mapply()` vs. `map2()`, `pmap()`
- `aggregate()` vs. `dplyr::summarize()`
- `by()` vs. `tidyverse::nest()`

The main content area has a large title "Relationship to base and plyr functions" and a section titled "Why not base?". It includes a paragraph about the need for a data-structure-informed iteration and a list of bullet points detailing what `purrr` provides.

You need a way to iterate in R in a data-structure-informed way.
What does that mean?

- Iterate over elements of a list
- Iterate over rows or columns of a 2-dimensional object
- Iterate over sub data frames induced by one or more factors
- Iterate over tuples formed from the i-th element of several vectors of equal length

All of this is absolutely possible with base R, using `for()` loops or

```
library(purrr)  
library(repurrrrutive)  
help(package = "repurrrrutive")
```



Get comfortable with **lists!**

atomic vectors are familiar:
logical, integer, double, character, etc

a **list** = a generalized vector

a list can hold almost anything



"working with lists"

How many elements are in got_chars?

Who is the 9th person listed in got_chars?

What information is given for this person?

What is the difference between got_chars[9] and got_chars[[9]]?

Or ... do same for sw_people or the n-th person

List exploration

`str(x, list.len = ?, max.level = ?)`

`x[i]`

`x[[i]]`

`str(x[[i]], ...)`

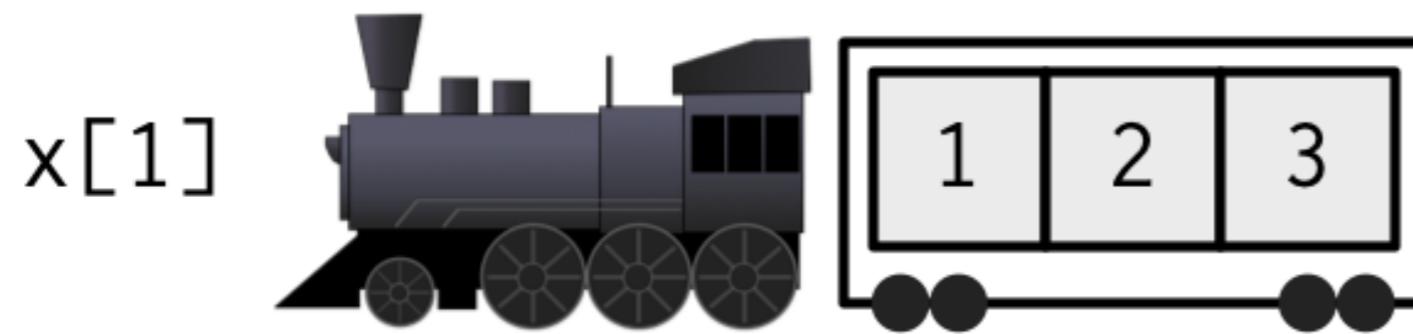
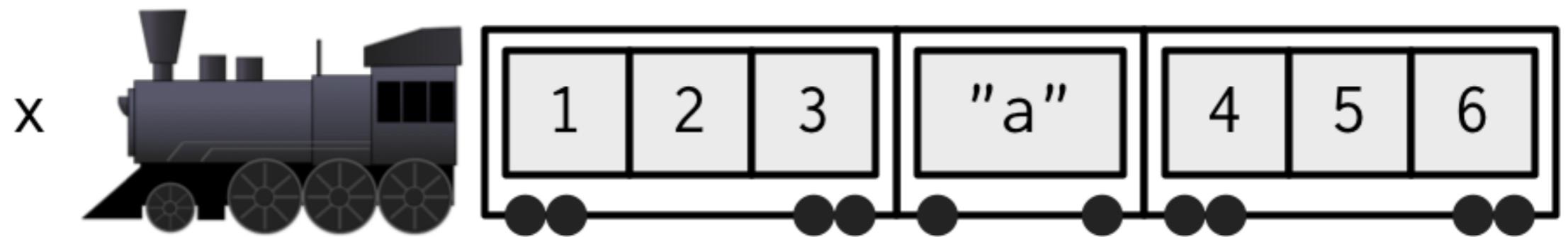
`View(x)`, in RStudio

If list `x` is a train carrying objects:

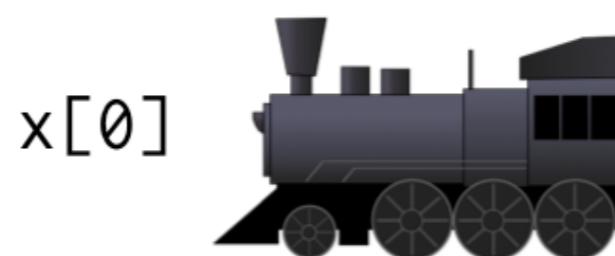
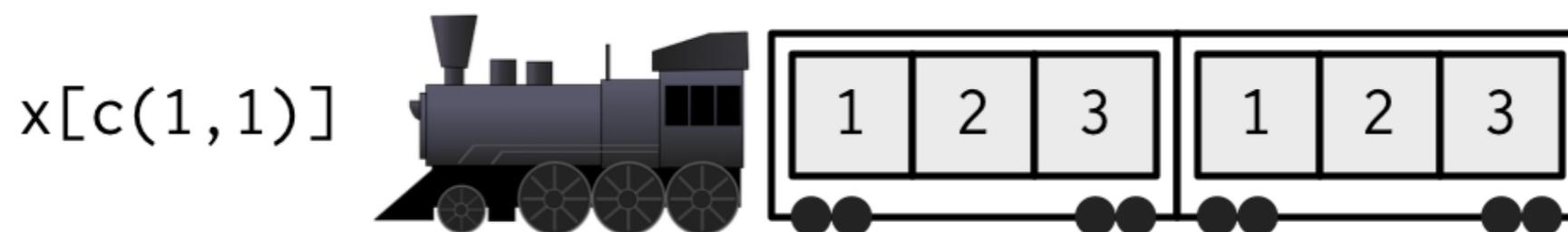
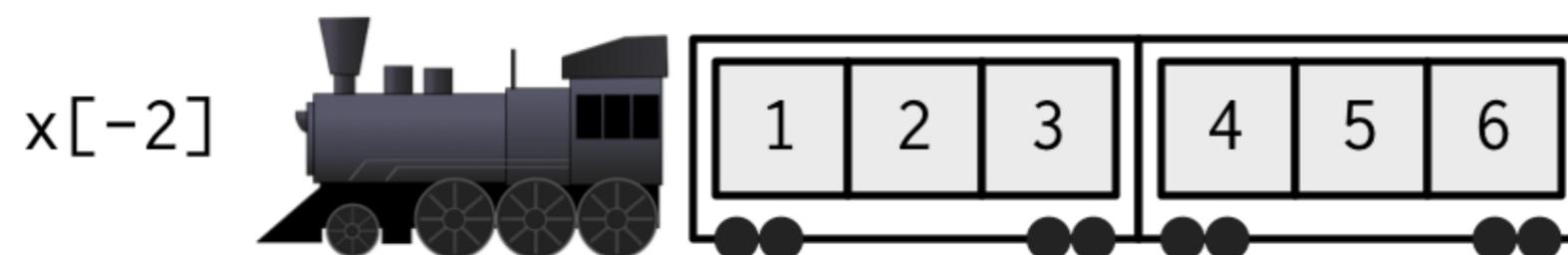
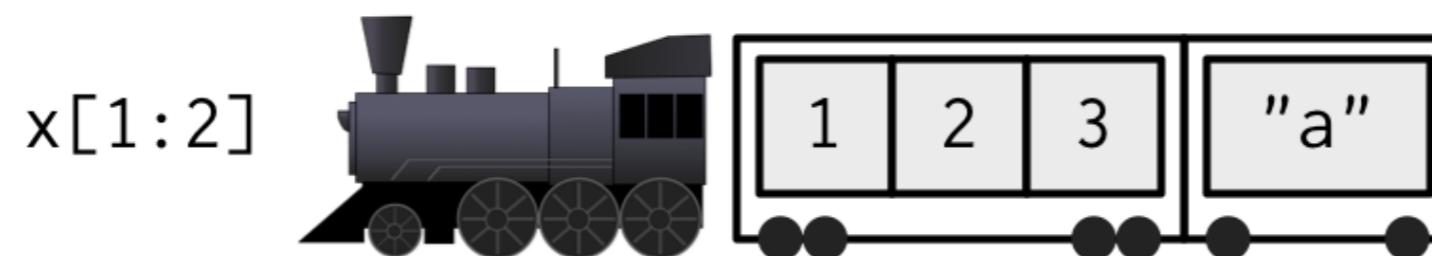
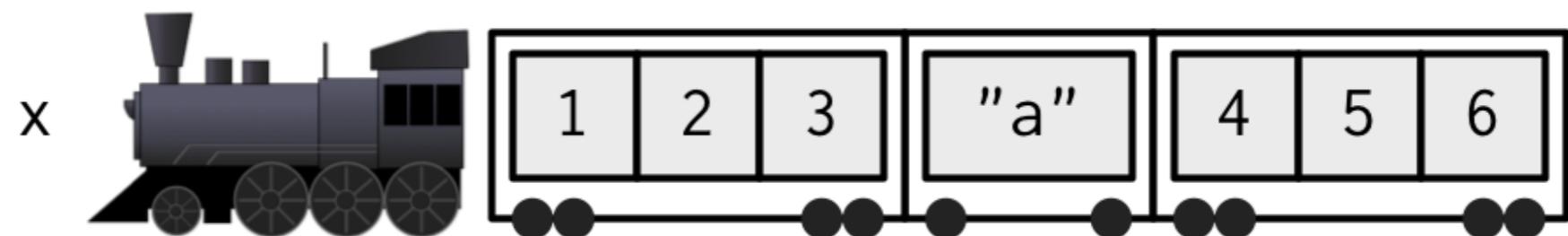
`x[5]` is the object in car 5

`x[4:6]` is a train of cars 4-6.

-- Tweet by @RLangTip



from Subsetting chapter of 2nd ed Advanced R



from Subsetting chapter of 2nd ed Advanced R



X

X [i]



X [[i]]



from

<http://r4ds.had.co.nz/vectors.html#lists-of-condiments>

```
purrr::  
map(.x, .f, ...)
```

```
purrr::  
map(.x, .f, ...)
```

for every element of **.x**

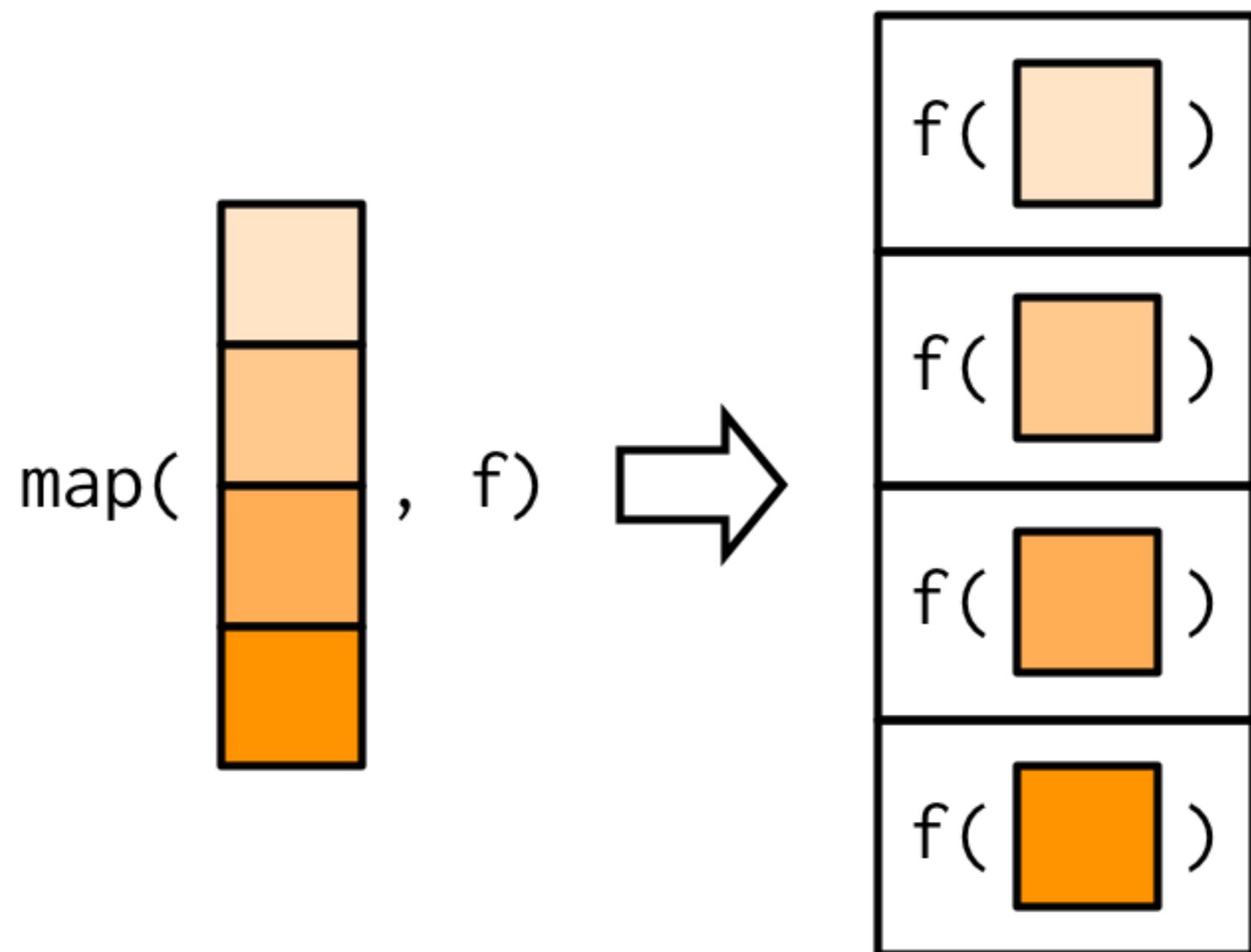
do **.f**

.x = minis



map(minis, antennate)





from Functionals chapter of 2nd ed Advanced R

purrr:: map(.x, .f)

```
.x <- SOME VECTOR OR LIST
out <- vector(mode = "list", length = length(.x))
for (i in seq_along(out)) {
  out[[i]] <- .f(.x[[i]])
}
out
```

purrr:: map(.x, .f)

```
.x <- SOME VECTOR OR LIST
out <- vector(mode = "list", length = length(.x))
for (i in seq_along(out)) {
  out[[i]] <- .f(.x[[i]])
}
out
```

purrr::map() is a nice way to
write a for loop.

How many aliases does each GoT
character have?

```
map(got_chars, .f = 🤔)
```

or

```
map(sw_people, .f = 🤔)
```

Workflow:

1. Do it for one element.
2. Find the general recipe.
3. Drop into `map()` to do for all.

Step 1: Do it for one element

```
daenerys <- got_chars[[9]]  
## View(daenerys)  
  
daenerys[["aliases"]]  
#> [1] "Dany"                      "Daenerys Stormborn"  
#> [3] "The Unburnt"                "Mother of Dragons"  
#> [5] "Mother"                     "Mhysa"  
#> [7] "The Silver Queen"          "Silver Lady"  
#> [9] "Dragonmother"              "The Dragon Queen"  
#> [11] "The Mad King's daughter"  
  
length(daenerys[["aliases"]])  
#> [1] 11
```

Step 1: Do it for one element

```
asha <- got_chars[[13]]  
## View(asha)  
  
asha[["aliases"]]  
#> [1] "Esgred"                      "The Kraken's Daughter"  
  
length(asha[["aliases"]])  
#> [1] 2
```

Step 2: Find the general recipe

```
x <- got_chars[?] ]
```

```
length(x[["aliases"]])
```

Step 2: Find the general recipe

```
x <- got_chars[?] ]
```

```
length(x[["aliases"]])
```

think of x as a pronoun, like "it"
means "the current element"

Step 3: Drop into map() to do for all

```
map(got_chars, \((x) length(x[["aliases"]])))  
#> [[1]]  
#> [1] 4  
#>  
#> [[2]]  
#> [1] 11  
#>  
#> [[3]]  
#> [1] 1  
#>  
#> [[4]]  
#> [1] 1  
#> ...
```

Base R's anonymous function syntax (a.k.a. "lambda function")

Introduced in R 4.1

Think of "\ as "function"



Step 3: Drop into map() to do for all

```
map(got_chars, ~ length(.x[["aliases"]]))  
#> [[1]]  
#> [1] 4  
#>  
#> [[2]]  
#> [1] 11  
#>  
#> [[3]]  
#> [1] 1  
#>  
#> [[4]]  
#> [1] 1  
#> ...
```



The old, original way, using the ~ syntax for anonymous functions.

This was a tidyverse invention, powered by the rlang package.

sidebar on anonymous functions

```
# regular function
f <- function(x) {
  length(x[["aliases"]])
}
map(got_chars, f)

# anonymous function, rlang / tidyverse
map(got_chars, ~ length(.x[["aliases"]]))

# anonymous function, base R's syntax ( $\geq 4.1$ )
map(got_chars, \(x) length(x[["aliases"]]))
```

sidebar on anonymous functions

as with the pipe,

the tidyverse is gradually switching
to the base syntax

so `|>` and `\(x)` are the future

Challenge (pick one or more!)

How many x does each (GoT or SW) character have? (x = titles, allegiances, vehicles, starships)

```
map(got_chars, \(x) length(x[["aliases"]]))
```

Oh, would you prefer an integer vector?

```
map_int(got_chars, \((x) length(x[["aliases"]]))  
#> [1] 4 11 1 1 1 1 1 1 11 5 16  
#> [12] 1 2 5 3 3 3 5 0 3 4 1  
#> [25] 8 2 1 5 1 4 7 3
```

map()

map_lgl()

map_int()

map_dbl()

map_chr()

type-specific
variants of map()

Challenge:

Replace map() with type-specific map()

```
# What's each character's name?
```

```
map(got_chars, \((x) x[["name"]]))
```

```
map(sw_people, \((x) x[["name"]]))
```

```
# What color is each SW character's hair?
```

```
map(sw_people, \((x) x[["hair_color"]]))
```

```
# Is the GoT character alive?
```

```
map(got_chars, \((x) x[["alive"]]))
```

```
# Is the SW character female?
```

```
map(sw_people, \((x) x[["gender"]]) == "female")
```

```
# How heavy is each SW character?
```

```
map(sw_people, \((x) x[["mass"]]))
```

Review

Lists can be awkward

Lists are necessary

Get to know your list

```
purrr::  
map(.x, .f, ...)
```

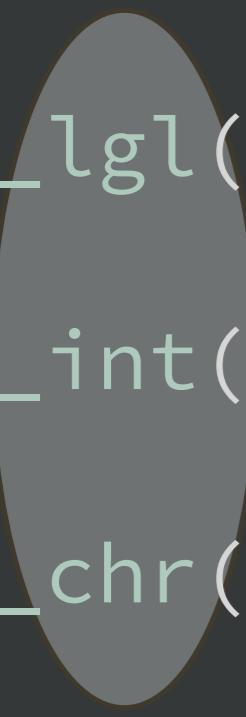
for every element of **.x**

do **.f**

```
purrr::  
map(.x, .f)
```

```
map(got_chars, \(x) length(x[["aliases"]]))
```

quick anonymous functions



```
map_lgl(sw_people, \$(x) x[["gender"]] == "female")  
map_int(got_chars, \$(x) length(x[["aliases"]]))  
map_chr(got_chars, \$(x) x[["name"]])
```

type-specific map

Onwards!

Notice:

We extract by name a lot

```
# What's each GoT character's name?  
map(got_chars, \((x) x[["name"]]))
```

```
# What color is each SW character's hair?  
map(sw_people, \((x) x[["hair_color"]]))
```

```
# Is the GoT character alive?  
map(got_chars, \((x) x[["alive"]]))
```

```
# How heavy is each SW character?  
map(sw_people, \((x) x[["mass"]]))
```

```
map_chr(got_chars, \(x) x[["name"]])
```



```
map_chr(got_chars, "name")
```

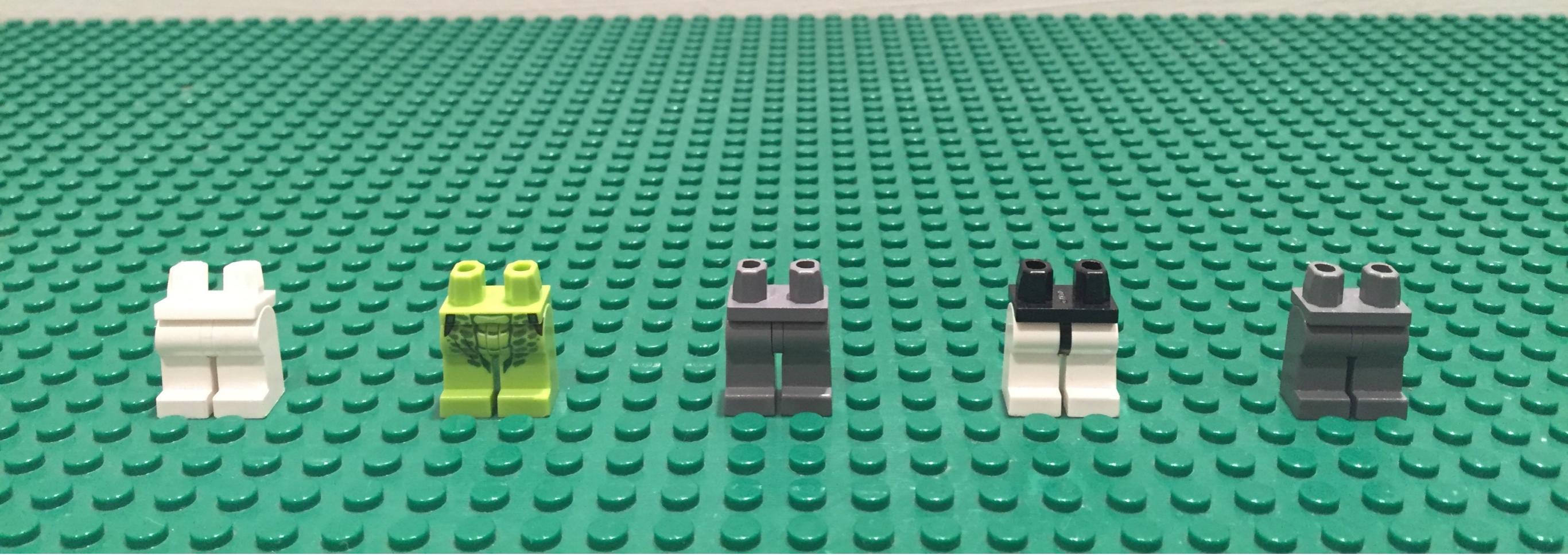
Shortcut!

.**f** accepts a name or position

.x = minis



map(minis, "pants")



Challenge:

Explore a GoT or SW list and find a new element to look at

Extract it across the whole list with name and position
shortcuts for . f

Use map_TYPE() to get an atomic vector as output

```
map_??(got_??, ??)  
map_??( sw_??, ??)
```

Common problem

I'm using `map_TYPE()` but some individual elements aren't of length 1.

They are absent or have $\text{length} > 1$.

Solutions

Missing elements?

Specify a `.default` value.

Elements of length > 1?

You can't make an atomic vector.*

Get happy with a list or list-column.

Or pick one element, e.g., the first.

* Well, you can, if you are willing to `flatten()`.

```
map(sw_vehicles, "pilots", .default = NA)
#> [[1]]
#> [1] NA
#>
#> ...
#>
#> [[19]]
#> [1] "http://swapi.co/api/people/10/" "http://swapi.co/api/people/32/"
#>
#> [[20]]
#> [1] "http://swapi.co/api/people/44/"
#>
#> ...
#>
#> [[37]]
#> [1] "http://swapi.co/api/people/67/"
#>
#> [[38]]
#> [1] NA
#>
#> [[39]]
#> [1] NA
```

```
map_chr(sw_vehicles, list("pilots", 1), .default = NA)
#> [1] NA
#> [3] NA
#> [5] "http://swapi.co/api/people/1/" NA
#> [7] NA "http://swapi.co/api/people/13/"
#> [9] NA
#> [11] NA
#> [13] "http://swapi.co/api/people/1/" NA
#> [15] NA
#> [17] NA
#> [19] "http://swapi.co/api/people/10/" "http://swapi.co/api/people/44/"
#> [21] "http://swapi.co/api/people/11/" "http://swapi.co/api/people/70/"
#> [23] "http://swapi.co/api/people/11/" NA
#> [25] NA "http://swapi.co/api/people/79/"
#> [27] NA
#> [29] NA
#> [31] NA
#> [33] NA
#> [35] NA
#> [37] "http://swapi.co/api/people/67/" NA
#> [39] NA
```

```
map(got_chars, c(14, 1))
```

```
map(sw_vehicles, list("pilots", 1))
```

Shortcut!

.**f** accepts a ~~name or position~~ vector of names or positions or a list of names and positions

Names make life nicer!

```
map_chr(got_chars, "name")
#> [1] "Theon Greyjoy"      "Tyrion Lannister"    "Victarion Greyjoy"
#> ...
#> ...

got_chars_named <- set_names(got_chars, map_chr(got_chars, "name"))

got_chars_named %>%
  map_lgl("alive")
#> Theon Greyjoy   Tyrion Lannister  Victarion Greyjoy
#> TRUE           TRUE             TRUE
#> ...
#> ...
```

Names propagate in purrr pipelines.
Set them early and enjoy!

tibble::enframe() does this: named list → df w/ names & list-column

```
allegiances <- map(got_chars_named, "allegiances")
tibble::enframe(allegiances, value = "allegiances")
#> # A tibble: 30 × 2
#>   name      allegiances
#>   <chr>     <list>
#> 1 Theon Greyjoy    <chr [1]>
#> 2 Tyrion Lannister <chr [1]>
#> 3 Victarion Greyjoy <chr [1]>
#> 4 Will          <NULL>
#> 5 Areo Hotah    <chr [1]>
#> 6 Chett         <NULL>
#> 7 Cressen       <NULL>
#> 8 Arianne Martell <chr [1]>
#> 9 Daenerys Targaryen <chr [1]>
#> 10 Davos Seaworth  <chr [2]>
#> # ... with 20 more rows
```

Review #2

Set list names for a happier life.

```
got_chars_named <- set_names(got_chars, map_chr(got_chars, "name"))
```

There are many ways to specify .f.

```
map(got_chars, \((x) length(x[["aliases"]])))  
map_chr(got_chars, "name")  
map(sw_vehicles, list("pilots", 1))
```

.default is useful for missing things.

```
map(sw_vehicles, "pilots", .default = NA)  
map_chr(sw_vehicles, list("pilots", 1), .default = NA)
```

Challenge:

Create a **named** copy of a GoT or SW list with `set_names()`.

Find an element with **tricky** presence/absence or length.

Extract it many ways:

- by name
- by position
- by `list("name", pos)` or `c(pos, pos)`
- use `.default` for missing data
- use `map_TYPE()` to coerce output to atomic vector

Challenge (pick one or more):

Which SW film has the most characters?

Which SW species has the most possible eye colors?

Which GoT character has the most allegiances? Aliases?
Titles?

Which GoT character has been played by multiple actors?

Inspiration for your
future iteration work
with purrr and the
tidyverse

```

library(tidyverse)
library(gapminder)

countries <- c("Argentina", "Brazil", "Canada")
gap_small <- gapminder |>
  filter(country %in% countries, year > 1996)
gap_small
#> # A tibble: 9 × 6
#>   country   continent   year   lifeExp     pop   gdpPercap
#>   <fct>     <fct>     <int>   <dbl>     <int>     <dbl>
#> 1 Argentina Americas    1997     73.3 36203463 10967.
#> 2 Argentina Americas    2002     74.3 38331121 8798.
#> 3 Argentina Americas    2007     75.3 40301927 12779.
#> 4 Brazil     Americas    1997     69.4 168546719 7958.
#> 5 Brazil     Americas    2002     71.0 179914212 8131.
#> 6 Brazil     Americas    2007     72.4 190010647 9066.
#> 7 Canada     Americas    1997     78.6 30305843 28955.
#> 8 Canada     Americas    2002     79.8 31902268 33329.
#> 9 Canada     Americas    2007     80.7 33390141 36319.

write_one <- function(x) {
  filename <- paste0(x, ".csv")
  dataset <- filter(gap_small, country == x)
  write_csv(dataset, filename)
}

walk(countries, write_one)
list.files(pattern = "*.csv")
#> [1] "Argentina.csv" "Brazil.csv"      "Canada.csv"

```

walk() is map() but
returns no output

[https://www.tidyverse.org/blog/
2023/05/purrr-walk-this-way/](https://www.tidyverse.org/blog/2023/05/purrr-walk-this-way/)

More goodies in "Saving
multiple outputs" in the
Iteration chapter of R for Data
Science

[https://r4ds.hadley.nz/
iteration.html#saving-multiple-outputs](https://r4ds.hadley.nz/iteration.html#saving-multiple-outputs)

list_rbind() rowbinds a list of data frames

```
library(tidyverse)
```

```
csv_files <- list.files(pattern = "*.csv")
csv_files
#> [1] "Argentina.csv" "Brazil.csv"      "Canada.csv"

csv_files %>
  map(\(x) read_csv(x, show_col_types = FALSE)) %>
  list_rbind()
#> # A tibble: 9 × 6
#>   country continent year lifeExp       pop gdpPercap
#>   <chr>     <chr>    <dbl>   <dbl>     <dbl>     <dbl>
#> 1 Argentina Americas  1997     73.3 36203463 10967.
#> 2 Argentina Americas  2002     74.3 38331121  8798.
#> 3 Argentina Americas  2007     75.3 40301927 12779.
#> 4 Brazil    Americas  1997     69.4 168546719 7958.
#> 5 Brazil    Americas  2002     71.0 179914212 8131.
#> 6 Brazil    Americas  2007     72.4 190010647 9066.
#> 7 Canada    Americas  1997     78.6 30305843 28955.
#> 8 Canada    Americas  2002     79.8 31902268 33329.
#> 9 Canada    Americas  2007     80.7 33390141 36319.
```

More goodies in "Reading
multiple files" in the Iteration
chapter of R for Data Science

[https://r4ds.hadley.nz/
iteration.html#reading-multiple-files](https://r4ds.hadley.nz/iteration.html#reading-multiple-files)

mapping over 2 or
more things in parallel



.y = hair
.x = minis



map2(minis, hair, enhair)





.y = weapons

.x = minis



map2(minis, weapons, arm)



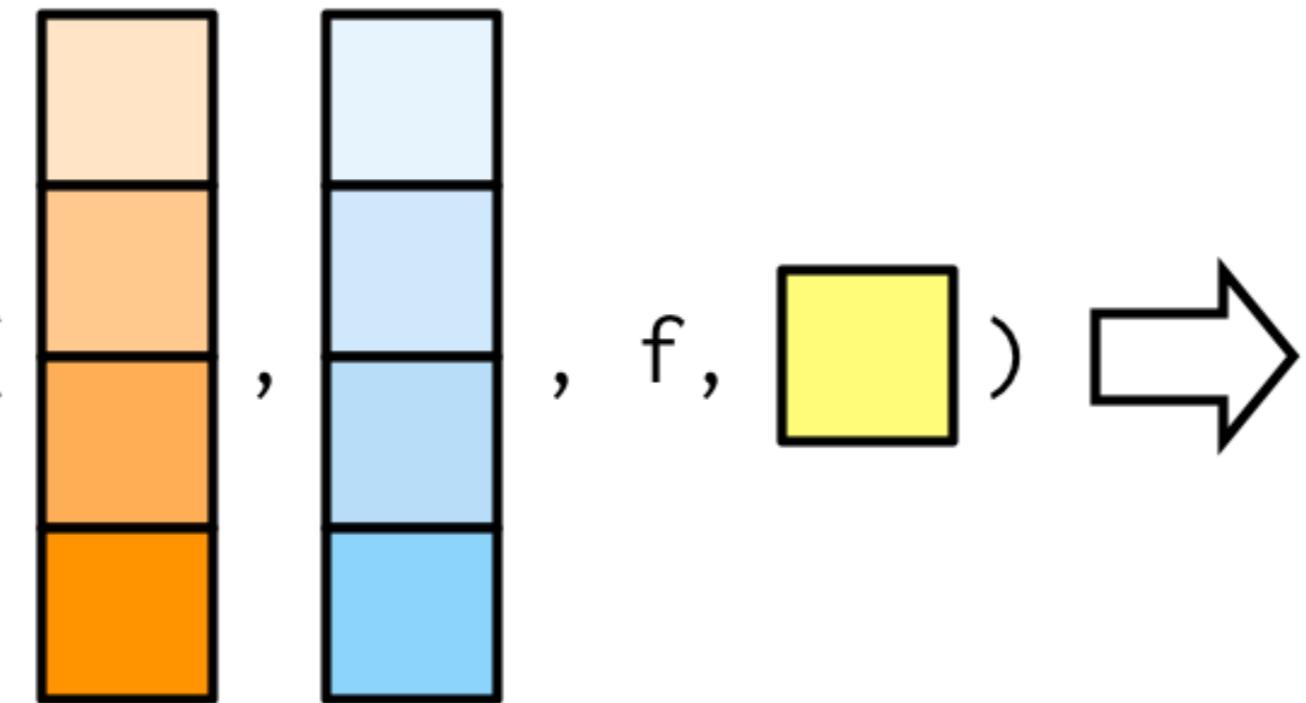
minis |>

map2(hair, enhair) |>

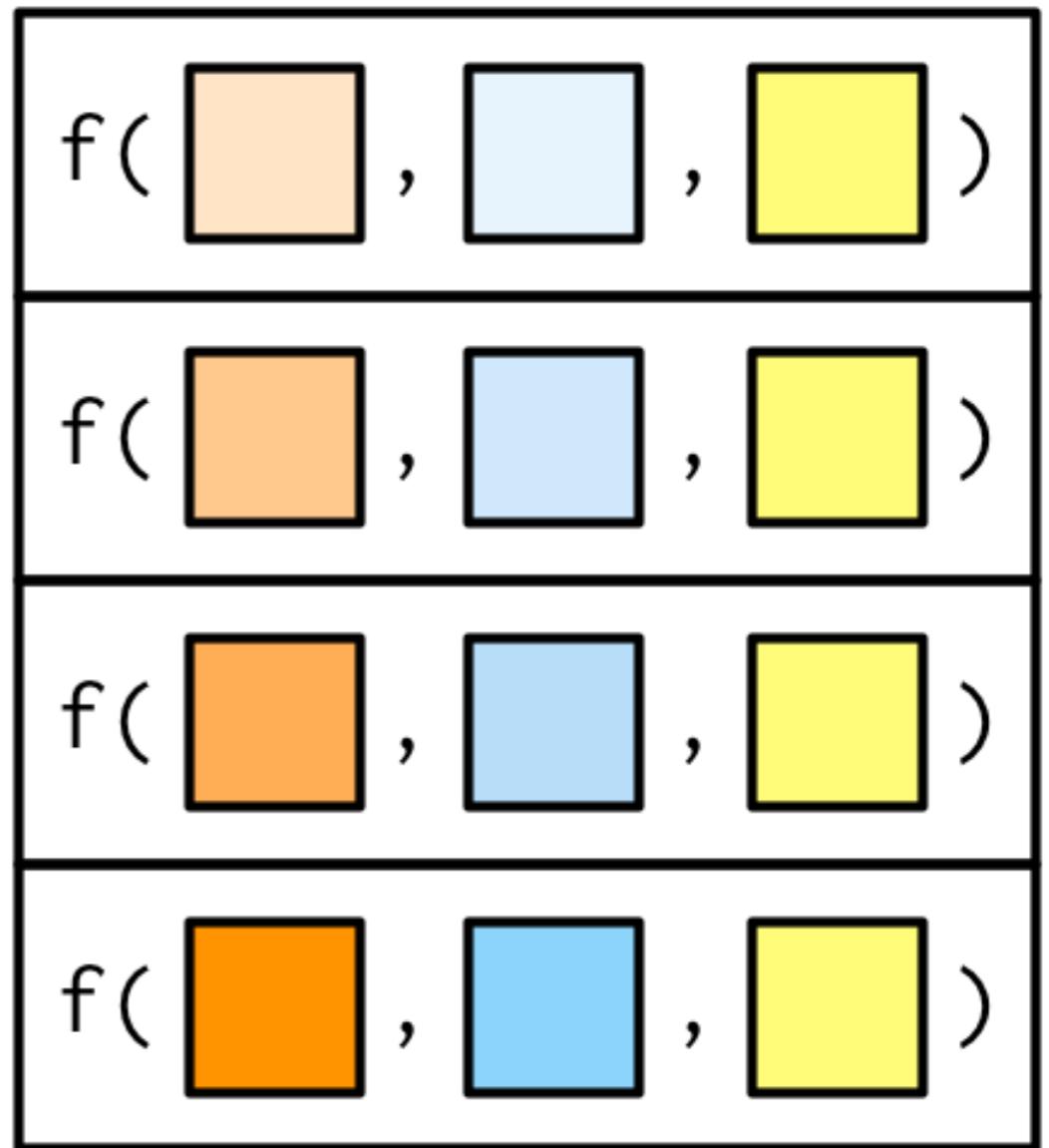
map2(weapons, arm)



`map2(`

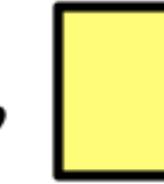


`, f,` `f`)



`f(`  `,`  `,`  `)`

`f(`  `,`  `,`  `)`

`f(`  `,`  `,`  `)`

`f(`  `,`  `,`  `)`

```
df <- tibble(pants, torso, head)
```

```
embody <- function(pants, torso, head)
```

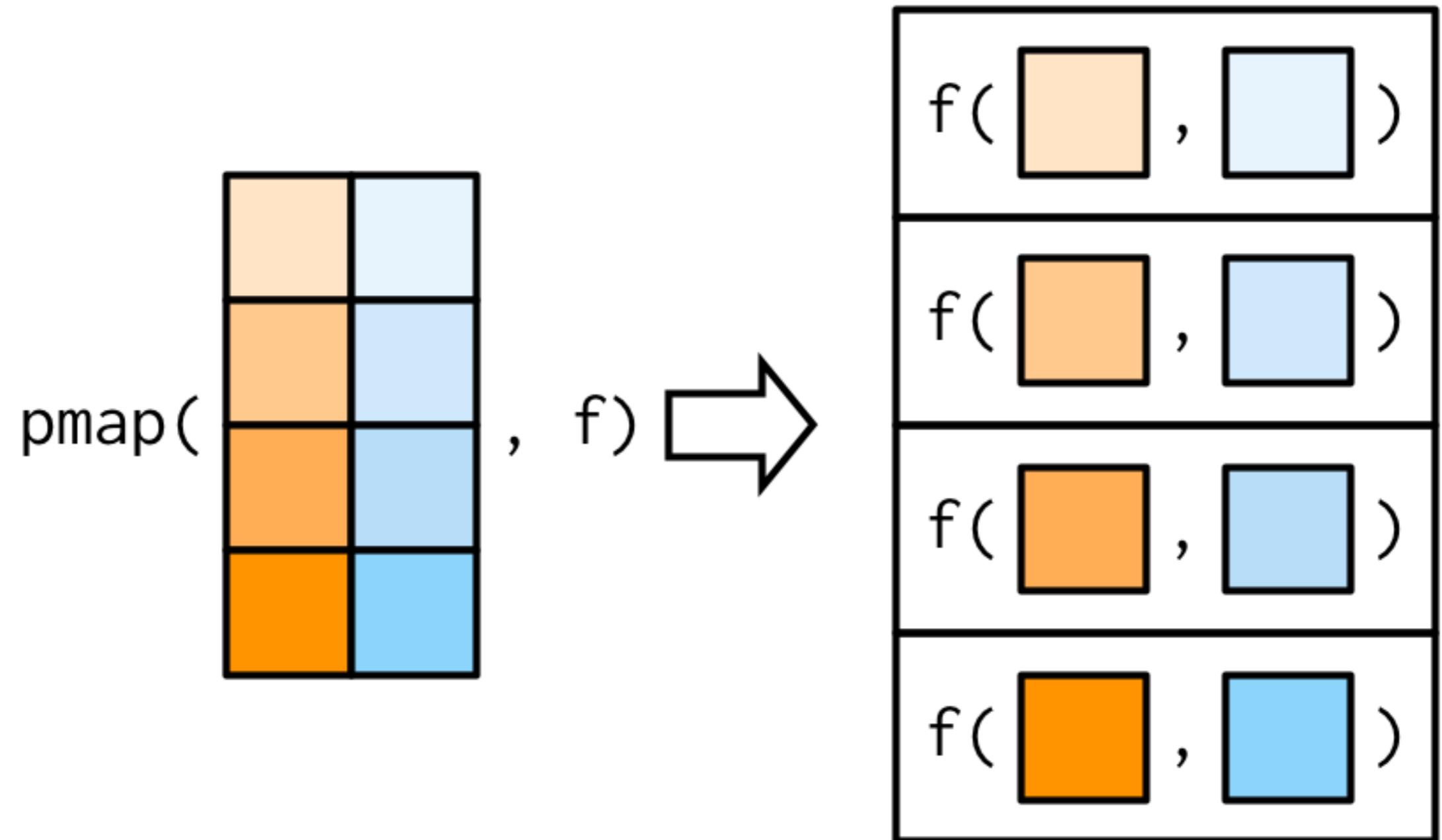
```
insert(insert(pants, torso), head)
```



pmap(df,

embody)





from Functionals chapter of 2nd ed Advanced R

For much more on this:
rstd.io/row-work

Row-oriented workflows in R with the tidyverse

Materials for [RStudio webinar](#) recording available at *this link!*:

Thinking inside the box: you can do that inside a data frame?!

Jenny Bryan

Wednesday, April 11 at 1:00pm ET / 10:00am PT

rstd.io/row-work <-- shortlink to this repo

Slides available [on SpeakerDeck](#)

You have the basis for exploring the world of purrr now!

	List	Atomic	Same type	Nothing
One argument	<code>map()</code>	<code>map_lgl()</code> , ...	<code>modify()</code>	<code>walk()</code>
Two arguments	<code>map2()</code>	<code>map2_lgl()</code> , ...	<code>modify2()</code>	<code>walk2()</code>
One argument + index	<code>imap()</code>	<code>imap_lgl()</code> , ...	<code>imodify()</code>	<code>iwalk()</code>
N arguments	<code>pmap()</code>	<code>pmap_lgl()</code> , ...	—	<code>pwalk()</code>

from Functionals chapter of 2nd ed Advanced R

Ironically, a goal of the tidyverse is to make you need purrr less!

Meaning: the goal is to make the most common "moves" possible using only dplyr and tidyr.

"Rectangling"

the art and craft of taking a deeply nested list (often sourced from wild caught JSON or XML) and taming it into a tidy data set of rows and columns

"Rectangling"

`tidyr::hoist()`

`tidyr::unnest_longer()`

`tidyr::unnest_wider()`

"Rectangling"

[https://tidyr.tidyverse.org/articles/
rectangle.html](https://tidyr.tidyverse.org/articles/rectangle.html)

```
library(tidyverse)
library(repurrrsive)

got_dat ← tibble(raw = got_chars)
got_dat ▷
  hoist(raw, "name", "culture", "alive", first_aliases = list("aliases", 1))
#> # A tibble: 30 × 5
#>   name           culture     alive first_aliases      raw
#>   <chr>          <chr>      <lgl>  <chr>            <list>
#> 1 Theon Greyjoy "Ironborn" TRUE   "Prince of Fools" <named list [15]>
#> 2 Tyrion Lannister  ""        TRUE   "The Imp"         <named list [15]>
#> 3 Victarion Greyjoy "Ironborn" TRUE   "The Iron Captain" <named list [15]>
#> 4 Will             ""        FALSE  ""               <named list [15]>
#> 5 Areo Hotah       "Norvoshi" TRUE   ""               <named list [15]>
#> 6 Chett            ""        FALSE  ""               <named list [15]>
#> 7 Cressen          ""        FALSE  ""               <named list [15]>
#> 8 Arianne Martell "Dornish"  TRUE   ""               <named list [15]>
#> 9 Daenerys Targaryen "Valyrian" TRUE   "Dany"          <named list [15]>
#> 10 Davos Seaworth "Westeros" TRUE   "Onion Knight" <named list [15]>
#> # i 20 more rows
```

```
library(tidyverse)
library(repurrrsive)

got_dat <- tibble(raw = got_chars)
got_dat %>
  hoist(raw, "name") %>
  unnest_wider(raw)
#> # A tibble: 30 × 18
#>   name      url     id gender culture born   died alive titles aliases father
#>   <chr>     <chr> <int> <chr>  <chr> <chr> <chr> <lgl> <list> <list> <chr>
#> 1 Theon Gre... http... 1022 Male   "Ironb..." "In ..." ""    TRUE  <chr>  <chr>  ""
#> 2 Tyrion La... http... 1052 Male   ""       "In ..." ""    TRUE  <chr>  <chr>  ""
#> 3 Victarion... http... 1074 Male   "Ironb..." "In ..." ""    TRUE  <chr>  <chr>  ""
#> 4 Will        http... 1109 Male   ""       ""       "In ..." FALSE <chr>  <chr>  ""
#> 5 Areo Hotah http... 1166 Male   "Norvo..." "In ..." ""    TRUE  <chr>  <chr>  ""
#> 6 Chett       http... 1267 Male   ""       "At ..." "In ..." FALSE <chr>  <chr>  ""
#> 7 Cressen    http... 1295 Male   ""       "In ..." "In ..." FALSE <chr>  <chr>  ""
#> 8 Arianne M... http... 130   Female "Dorni..." "In ..." ""    TRUE  <chr>  <chr>  ""
#> 9 Daenerys ... http... 1303 Female "Valyr..." "In ..." ""    TRUE  <chr>  <chr>  ""
#> 10 Davos Sea... http... 1319 Male   "Weste..." "In ..." ""   TRUE  <chr>  <chr>  ""
#> # i 20 more rows
#> # i 7 more variables: mother <chr>, spouse <chr>, allegiances <list>,
#> #   books <list>, povBooks <list>, tvSeries <list>, playedBy <list>
```

Row-wise operations

[https://dplyr.tidyverse.org/articles/
rowwise.html](https://dplyr.tidyverse.org/articles/rowwise.html)

`dplyr::rowwise()`

Column-wise operations

[https://dplyr.tidyverse.org/articles/
colwise.html](https://dplyr.tidyverse.org/articles/colwise.html)

`dplyr::across()`

```
library(tidyverse)
library(repurrrsive)

got_dat ← tibble(raw = got_chars)
got_dat ▷
  hoist(raw, "name") ▷
  unnest_wider(raw) ▷
  select(name, alive, allegiances, povBooks) ▷
  rowwise() ▷
  mutate(across(where(is.list), str_flatten_comma))
#> # A tibble: 30 × 4
#> # Rowwise:
#>   name           alive allegiances          povBooks
#>   <chr>        <lgcl> <chr>                <chr>
#> 1 Theon Greyjoy    TRUE  "House Greyjoy of Pyke"  A Clash...
#> 2 Tyrion Lannister  TRUE  "House Lannister of Casterly Rock" A Game ...
#> 3 Victarion Greyjoy  TRUE  "House Greyjoy of Pyke"  A Feast...
#> 4 Will              FALSE  ""                  A Game ...
#> 5 Areo Hotah       TRUE  "House Nymeros Martell of Sunspear" A Feast...
#> 6 Chett             FALSE  ""                  A Storm...
#> 7 Cressen           FALSE  ""                  A Clash...
#> 8 Arianne Martell   TRUE  "House Nymeros Martell of Sunspear" A Feast...
#> 9 Daenerys Targaryen TRUE  "House Targaryen of King's Landing" A Game ...
#> 10 Davos Seaworth  TRUE  "House Baratheon of Dragonstone, House Sea... A Clash...
```