Tidy-Tou[R]

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library(tidyverse)

Outline

- General motivation

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- tidyr

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- purrr

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- Transparency is an obligation
- Be lazy as possible
- Do as little “by hand” manipulation of data as possible
- Make your code fast and readable

Quick note to the experienced R users new to the tidyverse

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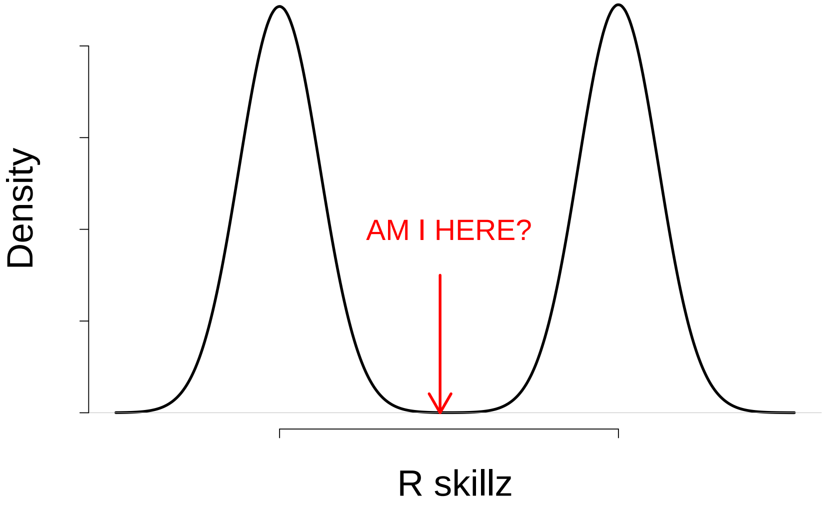
- Who?

Free book: Google “R for data science”

Who is my audience today?



The curse of data, data1, data2 . . .

```
data <- read.csv("datafile")
data1 <- data[,c(1,2,3)]
data2 <- subset(data1, column1 == "test")
data3 <- ...
```

Life is better with %>% (pipe)

Simple example with %>%

```r
iris[,3:5] %>%
  head(5)
```

```
##   Petal.Length Petal.Width Species
## 1          1.4         0.2  setosa
## 2          1.4         0.2  setosa
## 3          1.3         0.2  setosa
## 4          1.5         0.2  setosa
## 5          1.4         0.2  setosa
```

Emphasis on verbs instead of nouns

```
subject %>% (then)
  action1 %>% (then)
  action2 %>% (then)
  action3
```

Exercise

Get the 5th to last row of the `iris` dataframe using %>% twice
(there are much better ways to achieve this – just for practice)

My solution

```r
iris[,3:5] %>%
  tail(5) %>%
  head(1)
```

```
##     Petal.Length Petal.Width   Species
## 146          5.2         2.3 virginica
```

Using %>%

Benefits of approach include:

Readability

Scalability

Consistency

Ease of use

tidyr

Make some example data

```
samps <- 5
ducks <- data.frame(duck = rnorm(samps),
                    goose = c(rnorm(samps - 1), NA),
                    idx = 1:samps)
```

make data loooong

	duck	goose	idx
1	-1.17	-0.24	1
2	-0.46	-0.63	2
3	0.65	-2.49	3
4	-0.40	-0.66	4
5	-1.09		5

make data loooong

- What's the problem?

	duck	goose	idx
1	-1.17	-0.24	1
2	-0.46	-0.63	2
3	0.65	-2.49	3
4	-0.40	-0.66	4
5	-1.09		5

make data loooong

- How do we fix it?

	duck	goose	idx
1	-1.17	-0.24	1
2	-0.46	-0.63	2
3	0.65	-2.49	3
4	-0.40	-0.66	4
5	-1.09		5

tidyr::gather() makes data frames long

```r
ducks_td <- ducks %>%
  gather(key = "bird_type", value = "temp", -idx) %>%
  drop_na()
```

	idx	bird_type	temp
1	1	duck	-1.17
2	2	duck	-0.46
3	3	duck	0.65
4	4	duck	-0.40
5	5	duck	-1.09
6	1	goose	-0.24
7	2	goose	-0.63
8	3	goose	-2.49
9	4	goose	-0.66

`tidyr::spread()` makes data wide (sometimes useful)

```
ducks_wd <- ducks_td %>%
  spread(bird_type, temp)
```

	idx	duck	goose
1	1	-1.17	-0.24
2	2	-0.46	-0.63
3	3	0.65	-2.49
4	4	-0.40	-0.66
5	5	-1.09	

Exercise

- Check out the `VADeaths` data matrix (comes with base r)

Exercise

- Check out the `VADeaths` data matrix (comes with base r)
- Make `VADeaths` a data frame, *then* make it long

One solution

```r
data.frame(VADeaths) %>%
  gather(key = "municipal.sex", value = "deaths_K") %>%
  head(5)
```

```
##   municipal.sex deaths_K
## 1    Rural.Male     11.7
## 2    Rural.Male     18.1
## 3    Rural.Male     26.9
## 4    Rural.Male     41.0
## 5    Rural.Male     66.0
```

tidyr::separate() to split a single variable into multiple

```
data.frame(VADeaths) %>%
  gather(key = "municipal.sex", value = "deaths_K") %>%
  separate(col = municipal.sex,
           into = c("munic","sx"),
           sep = "\\.") %>%
  head(5)
```

```
##   munic   sx deaths_K
## 1 Rural Male     11.7
## 2 Rural Male     18.1
## 3 Rural Male     26.9
## 4 Rural Male     41.0
## 5 Rural Male     66.0
```

dplyr: a glorious catch-all tool

dplyr

- dplyr can do more than what I could show in 50 minutes

dplyr

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- I still have a lot to learn about the functions

dplyr

- dplyr can do more than what I could show in 50 minutes
- I still have a lot to learn about the functions
- Let's talk about a few

`dplyr::select()` for accessing columns

```
#by index, name, or mixture of two
iris %>%
  select(1, Petal.Length) %>%
  head(5)
```

```
##   Sepal.Length Petal.Length
## 1          5.1          1.4
## 2          4.9          1.4
## 3          4.7          1.3
## 4          4.6          1.5
## 5          5.0          1.4
```

dply::arrange() for ordering rows

```
#desc() for descending order
iris %>%
  arrange(Species, Sepal.Width, desc(Sepal.Length)) %>%
  select(Sepal.Width, Sepal.Length, Species) %>%
  head(5)
```

```
##   Sepal.Width Sepal.Length Species
## 1         2.3          4.5  setosa
## 2         2.9          4.4  setosa
## 3         3.0          5.0  setosa
## 4         3.0          4.9  setosa
## 5         3.0          4.8  setosa
```

`dply::filter()` is like base r's `subset()`

```
#notice all columns would be returned w/o pipe to select()
iris %>%
  filter(Species == "setosa", Sepal.Length < 6) %>%
  select(Sepal.Length, Species) %>%
  head(5)
```

```
##   Sepal.Length Species
## 1          5.1  setosa
## 2          4.9  setosa
## 3          4.7  setosa
## 4          4.6  setosa
## 5          5.0  setosa
```

dply::mutate() add new columns

```r
iris %>%
  mutate(Sepal.Area = Sepal.Length * Sepal.Width) %>%
  select(Sepal.Area, Species) %>%
  head(5)
```

```
##   Sepal.Area Species
## 1      17.85  setosa
## 2      14.70  setosa
## 3      15.04  setosa
## 4      14.26  setosa
## 5      18.00  setosa
```

dply::group_by() and dply::summarise()

```r
#note: group_by() can be used with multiple variables
iris %>%
  group_by(Species) %>%
  summarise(mean_SL = mean(Sepal.Length),
            sd_SL = sd(Sepal.Length),
            q25 = quantile(Sepal.Length, 0.25),
            q75 = quantile(Sepal.Length, 0.75))
```

```
## # A tibble: 3 × 5
##      Species mean_SL     sd_SL   q25   q75
##       <fctr>   <dbl>     <dbl> <dbl> <dbl>
## 1     setosa   5.006 0.3524897 4.800   5.2
## 2 versicolor   5.936 0.5161711 5.600   6.3
## 3  virginica   6.588 0.6358796 6.225   6.9
```

dply::sample_n()

```r
#also see new modelr package for more like this
iris %>%
  sample_n(2) %>%
  select(Petal.Length, Species)
```

```
##     Petal.Length    Species
## 98           4.3 versicolor
## 108          6.3  virginica
```

dply::sample_frac()

```
iris %>%
  sample_frac(0.02) %>%
  select(Petal.Length, Species)
```

```
##     Petal.Length    Species
## 97           4.2 versicolor
## 144          5.9  virginica
## 14           1.1     setosa
```

group_by() and n()

```r
#surprisingly hard in base R
iris %>%
  group_by(Species) %>%
  mutate(counts = n()) %>%
  select(Species, counts) %>%
  sample_n(2)
```

```
## Source: local data frame [6 x 2]
## Groups: Species [3]
##
##      Species counts
##       <fctr>  <int>
## 1     setosa     50
## 2     setosa     50
## 3 versicolor     50
## 4 versicolor     50
## 5  virginica     50
```

Exercise

Using the tidy version of VADeaths, generate a mean and variance for the number of deaths for each municipal-sex combination (group by municipality and sex, *then* computer the mean and standard deviation of deaths).

One solution

```
death_sum <- data.frame(VADeaths) %>%
  gather(key = "municipal.sex", value = "deaths_K") %>%
  separate(col = municipal.sex,
           into = c("munic","sx"), sep = "\\.") %>%
  group_by(munic, sx) %>%
  summarise(mean_death = mean(deaths_K),
            sd_death = sd(deaths_K))
```

Result

	munic	sx	mean_death	sd_death
1	Rural	Female	25.18	18.42
2	Rural	Male	32.74	21.60
3	Urban	Female	25.28	17.06
4	Urban	Male	40.48	22.58

ggplot2

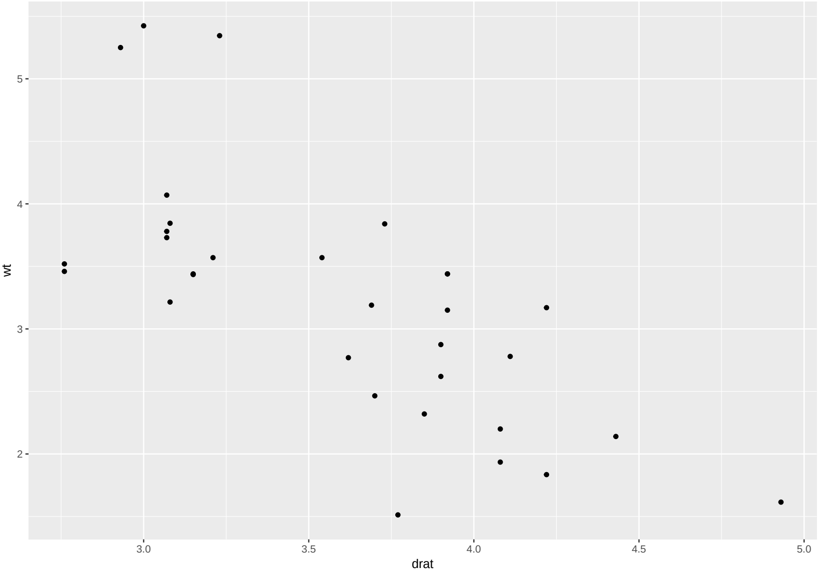
ggplot2 template

```
#default:
ggplot(data = <DATA>) +
  <GEOM_FUNCTION>(mapping = aes(<MAPPINGS>))

#alternative 1:
<DATA> %>%
  ggplot( ) +
  <GEOM_FUNCTION>(mapping = aes(<MAPPINGS>))

#alternative 2 (my usual preference):
<DATA> %>%
  ggplot(mapping = aes(<MAPPINGS>)) +
  <GEOM_FUNCTION>()
```

simple example

```
p <- mtcars %>%
  ggplot(aes(x = drat, y = wt)) +
  geom_point()
```

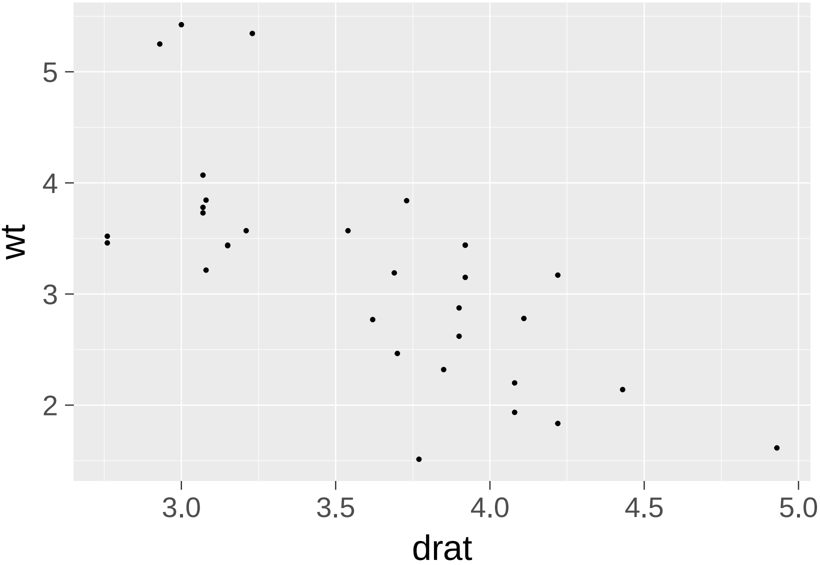
simple example 1



Looks bad on my screen, but easy to fix

```
p <- mtcars %>%
  ggplot(aes(x = drat, y = wt)) +
  geom_point() +
  theme_gray(base_size = 30)
```

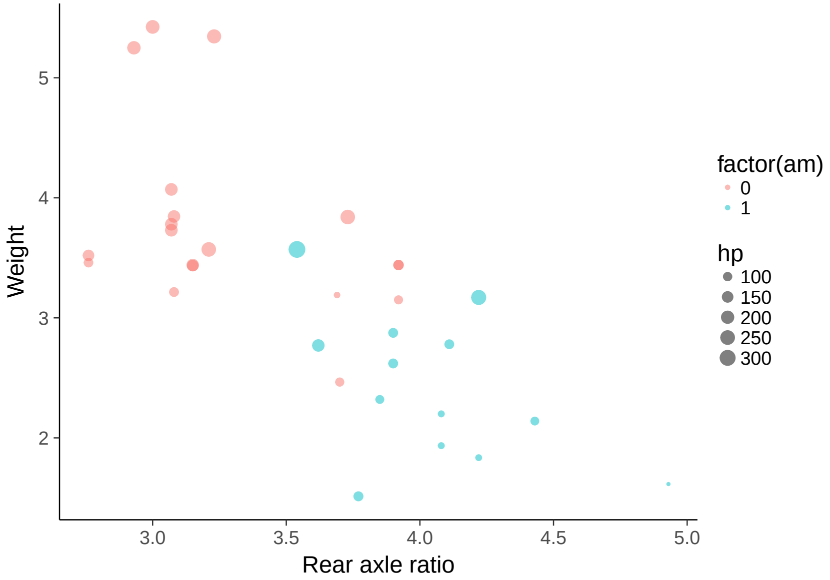
simple example 1



simple example 2

```r
p <- mtcars %>%
  ggplot(aes(x = drat, y = wt, size = hp)) +
  geom_point(aes(colour = factor(am)), alpha = 0.5) +
  xlab("Rear axle ratio") +
  ylab("Weight") +
  theme_classic(base_size = 20)
```

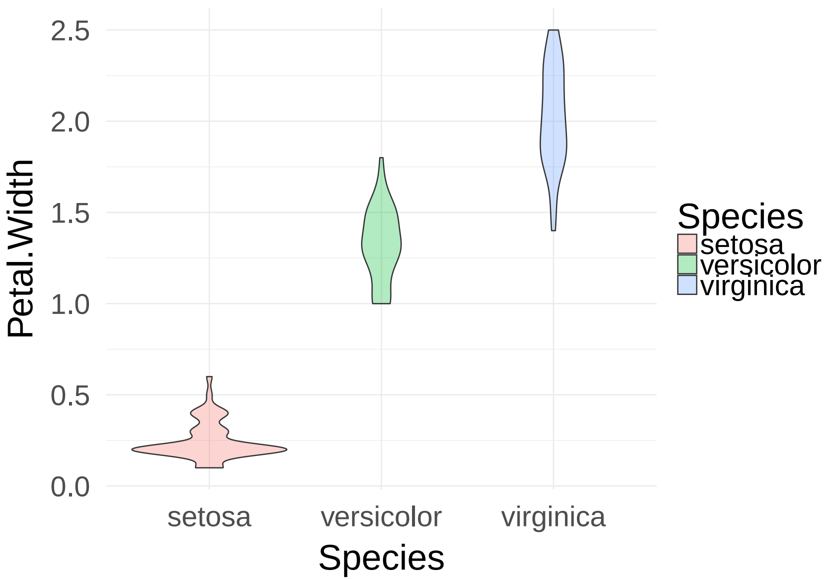
simple example 2



violin plots are cool!

```r
p <- iris %>%
  ggplot(aes(x = Species,
             y = Petal.Width,
             fill = Species)) +
  geom_violin(alpha = 0.3) +
  theme_minimal(base_size = 30)
```

Result

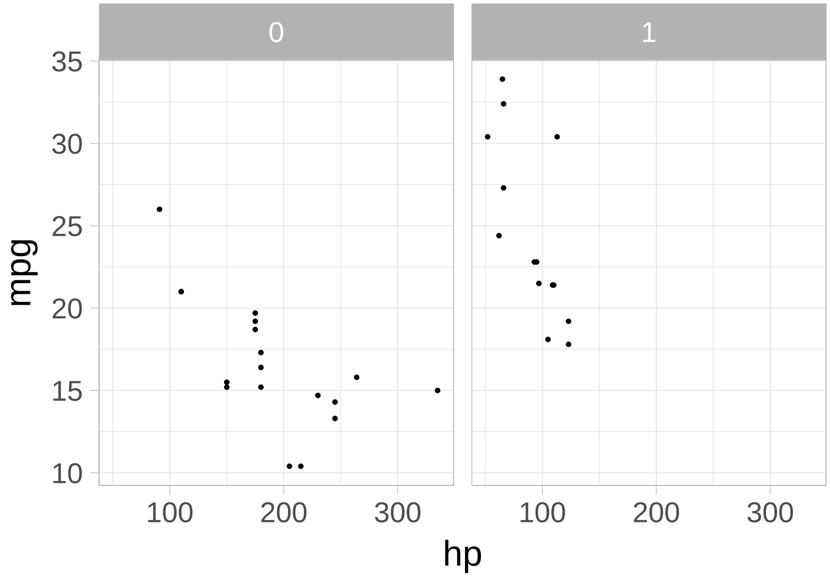


2.5
2.0
1.5
1.0
0.5
0.0
Petal.Width
setosa
versicolor
virginica
Species
Species
setosa
versicolor
virginica

Plots with multiple panels

```
p <- mtcars %>%
  ggplot(aes(x = hp, y = mpg)) +
  geom_point() +
  facet_wrap(~ vs) +
  theme_light(base_size = 30)
```

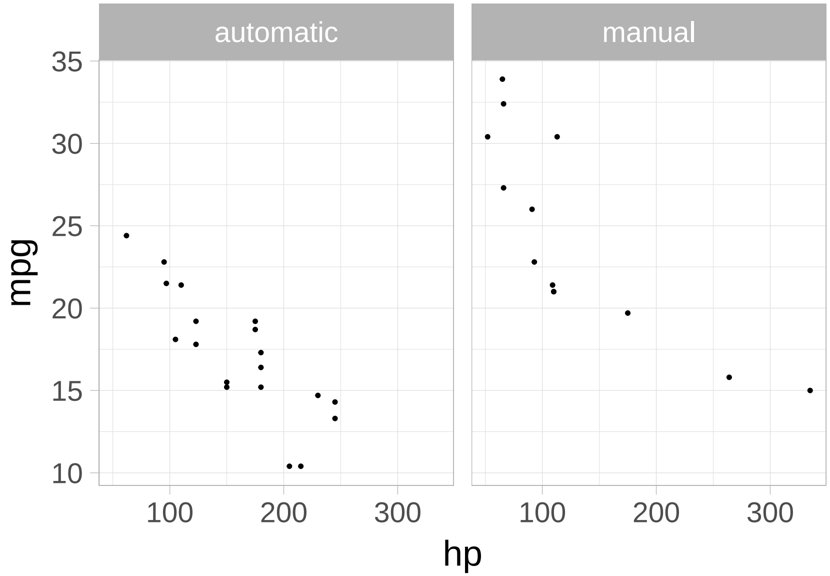
Result



Plots with multiple panels

```
p <- mtcars %>%
  mutate(tran = ifelse(am == 0,
                       "automatic",
                       "manual")) %>%
  ggplot(aes(x = hp, y = mpg)) +
  geom_point() +
  facet_wrap(~ tran) +
  theme_light(base_size = 30)
```

Result


automatic
manual
35
30
25
20
15
10
mpg
100
200
300
100
200
300
hp

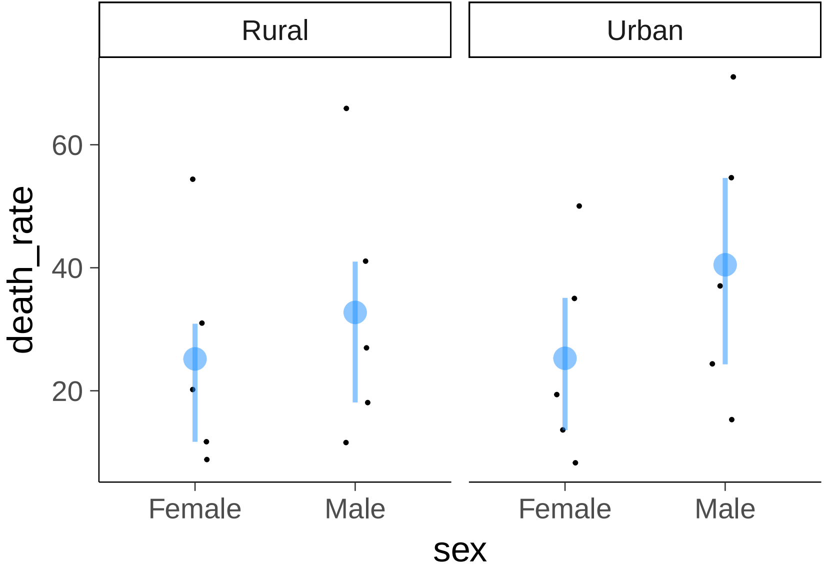
Exercise

Using the tidiest version of VADeaths, make a plot of death rate by sex, with panels for municipal

My solution

```
p <- data.frame(VADeaths) %>%
  mutate(age_group = rownames(VADeaths)) %>%
  gather("pop_group", "death_rate", -age_group) %>%
  separate(pop_group, c("municipal","sex"),
           sep = "\\.") %>%
  ggplot(aes(x = sex, y = death_rate)) + #new stuff below
  geom_jitter(width = 0.1) +
  facet_grid(~municipal) +
  geom_pointrange(stat = "summary",
                  fun.ymin = function(z) quantile(z,0.25),
                  fun.ymax = function(z) quantile(z,0.75),
                  fun.y = mean, colour = "dodgerblue",
                  alpha = 0.5, lwd = 2) +
  theme_classic(base_size = 30)
```

Result



purrr:functional programming (like lapply/sapply, but safer)

Explicit loops are slow (in R) and tedious to write

```r
#for example
vec <- 1:4

store <- rep(NA, length(vec))
for(i in vec){
  store[i] <- i*2
}
store
```

```
## [1] 2 4 6 8
```

functional “loop” version

```r
vec <- 1:4

vec %>%
  map_dbl(function(x) x * 2)
```

```
## [1] 2 4 6 8
```

```r
# or
vec %>%
  map_dbl(~ .x * 2)
```

```
## [1] 2 4 6 8
```

But don't do either of the above for this (`vec*2`)

purrr::map functions: also a lot more than I can discuss

- `map()` – returns a list

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- `map()` – returns a list
- `map_dbl()` – returns a vector of doubles
- `map_lgl()` – returns a vector of integers
- `map_int()` – returns a vector of integers
- `map_df()` – returns a dataframe

Important to understand lists and other data types

```r
my_list <- list(1, TRUE, rnorm(2), "lists!!")
#access with double brackets [[]]
my_list[[3]]
```

```
## [1] 0.8921948 0.6784726
```

purrr::map()

```r
#I() is the identity function
#same as function(x) x
my_list %>%
  map(I)
```

```
## [[1]]
## [1] 1
##
## [[2]]
## [1] TRUE
##
## [[3]]
## [1] 0.8921948 0.6784726
##
## [[4]]
## [1] "lists!!"
```

purrr::map_dbl()

```
mtcars %>%
  map_dbl(mean) %>%
  head(5)
```

```
##       mpg       cyl      disp        hp      drat
##  20.090625   6.187500 230.721875 146.687500   3.596563
```

purrr::map_lgl()

```
mtcars %>%
  map_lgl(is.numeric) %>%
  head(5)
```

```
##  mpg  cyl disp   hp drat
## TRUE TRUE TRUE TRUE TRUE
```

purrr::map_int()

```r
mtcars %>%
  map_int(length) %>%
  head(5)
```

```
##  mpg  cyl disp   hp drat
##   32   32   32   32   32
```

purrr::map_df()

```r
1:4 %>%
  map_df( ~ data.frame(rbind(rnorm(3))))
```

```
##           X1         X2        X3
## 1 -0.4761087 -0.2867547 0.4221558
## 2 -0.6924905  0.5708493 0.3160277
## 3  0.3623887  0.4145315 1.2019817
## 4  1.6175333  0.8349768 1.6647959
```

Here's a weird one

```
df_list <- list(mtcars = mtcars,
                iris = iris,
                VADeaths = VADeaths)

#the nrow function isn't important,
#the ability to utilize any function here is.
df_list %>% map_int(nrow)
```

```
##   mtcars     iris VADeaths
##       32      150        5
```