Functions and iteration

Week 12

AEM 2850 / 5850 : R for Business Analytics
Cornell Dyson
Fall 2025

Acknowledgements: Claus Wilke

Announcements

Group project due this Friday, November 14!

Office hours for the rest of this week:

- Tuesday: Prof. Gerarden open office hours from 11:30-12:30 in Warren 464
- Thursday: Prof. Gerarden by appointment at aem2850.youcanbook.me
- Friday: TA office hours from 1:00-2:00 in Warren B05

We will have a homework this week (due Monday 11/17)

- Will work through part of the homework on Thursday in class
- We will have regular TA office hours on Monday

Questions before we get started?

Plan for this week

Tuesday

- Intro to functions and iteration
- example-12

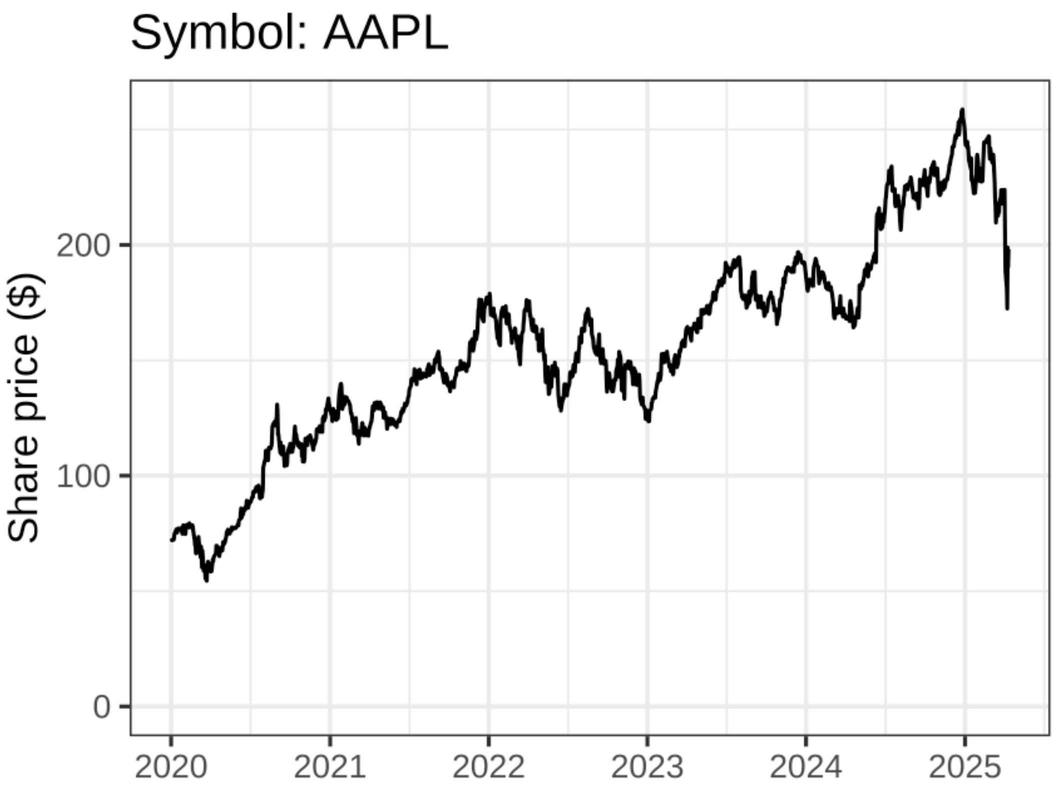
Thursday

- Conditional execution
- Functions with multiple arguments
- homework-12

Intro to functions and iteration

We often run similar code multiple times

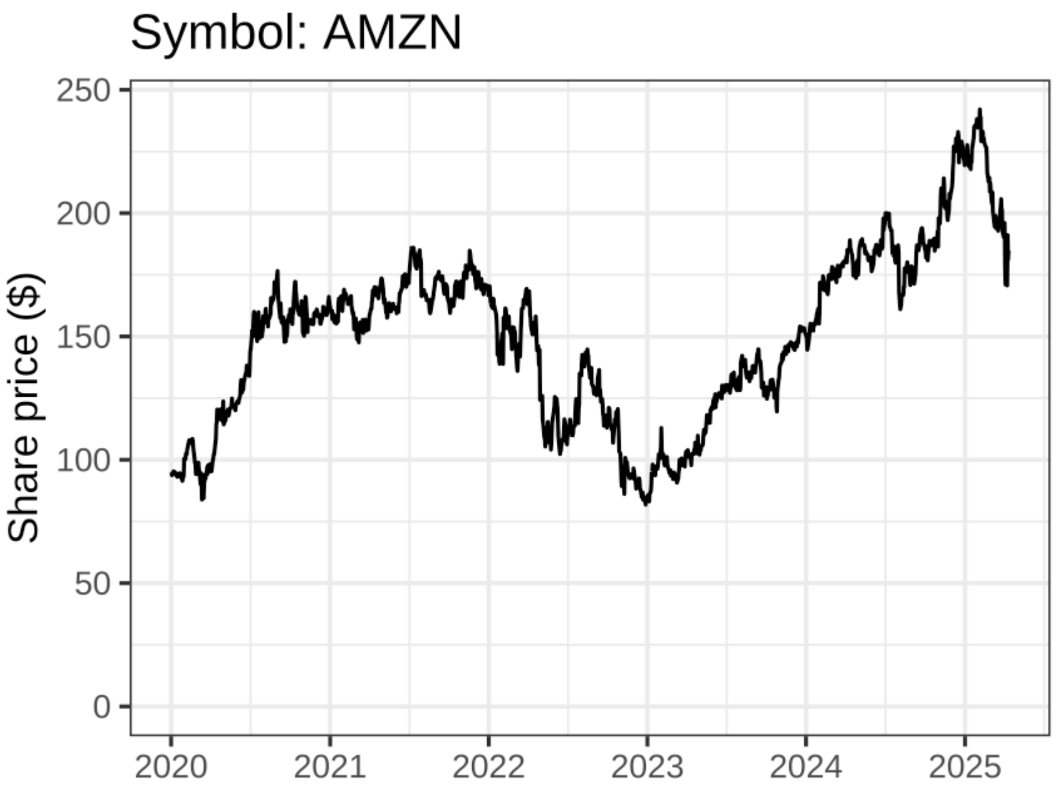
```r
sp500_prices |>
  filter(symbol == "AAPL") |>
  ggplot(aes(x = date, y = adjusted)) +
  geom_line() +
  labs(x = NULL,
       y = "Share price ($)",
       title = "Symbol: AAPL") +
  scale_x_date(date_breaks = "1 year",
               date_labels = "%Y") +
  scale_y_continuous(limits = c(0, NA)) +
  theme_bw()
```



What needs to change if we want to look at AMZN share prices instead?

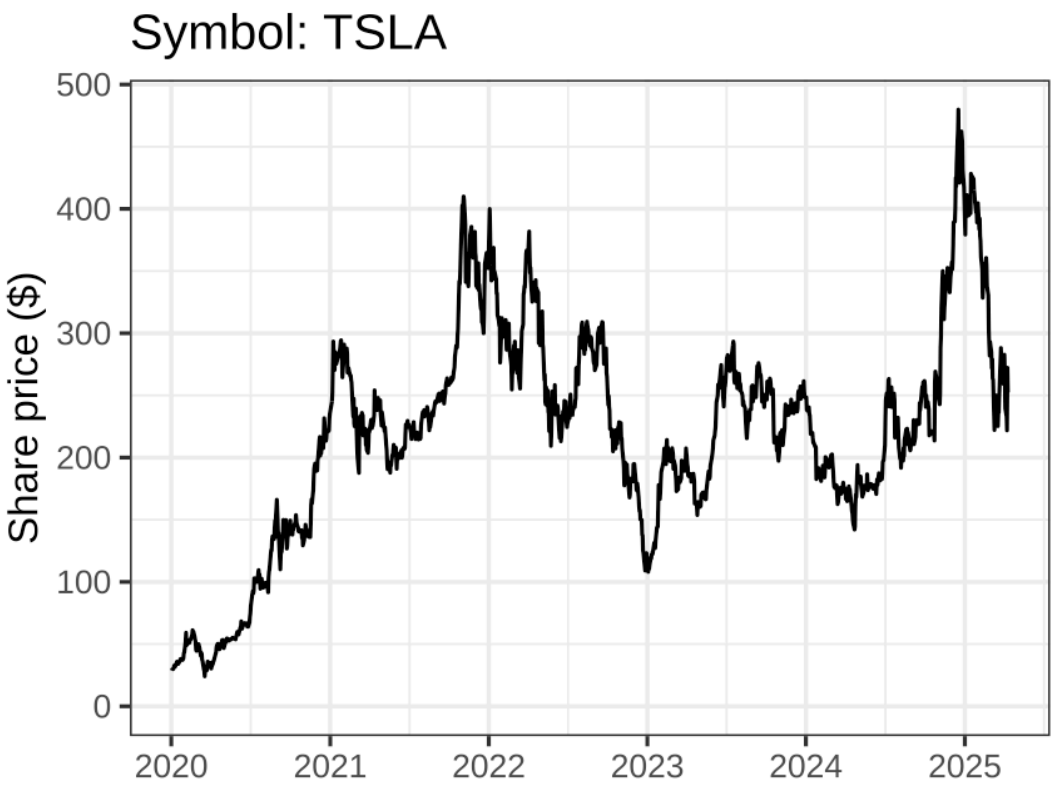
We often run similar code multiple times

```
sp500_prices |>
  filter(symbol == "AMZN") |>
  ggplot(aes(x = date, y = adjusted)) +
  geom_line() +
  labs(x = NULL,
       y = "Share price ($)",
       title = "Symbol: AMZN") +
  scale_x_date(date_breaks = "1 year",
               date_labels = "%Y") +
  scale_y_continuous(limits = c(0, NA)) +
  theme_bw()
```



We often run similar code multiple times

```r
sp500_prices |>
  filter(symbol == "TSLA") |>
  ggplot(aes(x = date, y = adjusted)) +
  geom_line() +
  labs(x = NULL,
       y = "Share price ($)",
       title = "Symbol: TSLA") +
  scale_x_date(date_breaks = "1 year",
               date_labels = "%Y") +
  scale_y_continuous(limits = c(0, NA)) +
  theme_bw()
```



How can we avoid duplication and mistakes?

1. **Avoid hard-coding specific values**
2. **Define a function**
3. **Automate calling the function**
4. Write a more general function
5. Use these concepts in a tidy pipeline

We will focus on steps 1-3 due to time constraints

Step 1: Avoid hard-coding specific values

```
sp500_prices |>
  filter(symbol == "AAPL") |>
  ggplot(aes(x = date, y = adjusted)) +
  geom_line() +
  labs(x = NULL,
       y = "Share price ($)",
       title = "Symbol: AAPL") +
  scale_x_date(date_breaks = "1 year",
               date_labels = "%Y") +
  scale_y_continuous(limits = c(0, NA)) +
  theme_bw()
```

What is "hard-coded" here?

Step 1: Avoid hard-coding specific values

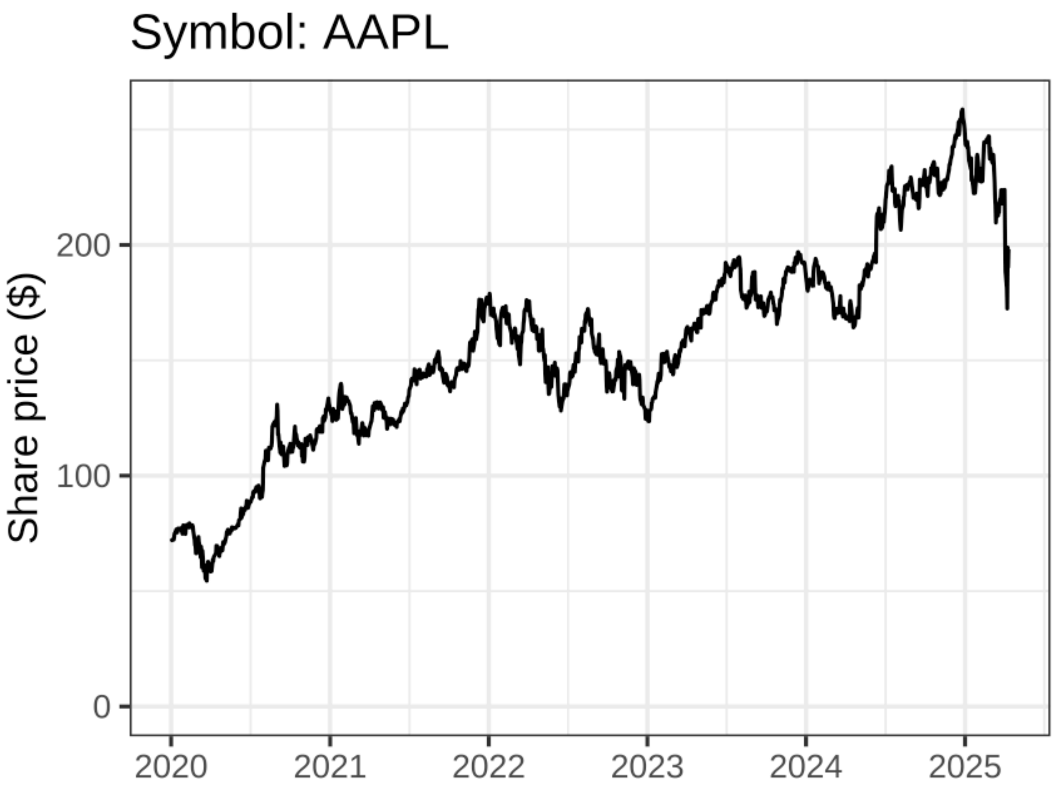
```r
sp500_prices |>
  filter(symbol == "AAPL") |>
  ggplot(aes(x = date, y = adjusted)) +
  geom_line() +
  labs(x = NULL,
       y = "Share price ($)",
       title = "Symbol: AAPL") +
  scale_x_date(date_breaks = "1 year",
               date_labels = "%Y") +
  scale_y_continuous(limits = c(0, NA)) +
  theme_bw()
```

How can we avoid this hard-coding?

Step 1: Avoid hard-coding specific values

```r
ticker <- "AAPL"

sp500_prices |>
  filter(symbol == ticker) |>
  ggplot(aes(x = date, y = adjusted)) +
  geom_line() +
  labs(x = NULL,
       y = "Share price ($)",
       title = str_glue("Symbol: {ticker}")) +
  scale_x_date(date_breaks = "1 year",
               date_labels = "%Y") +
  scale_y_continuous(limits = c(0, NA)) +
  theme_bw()
```

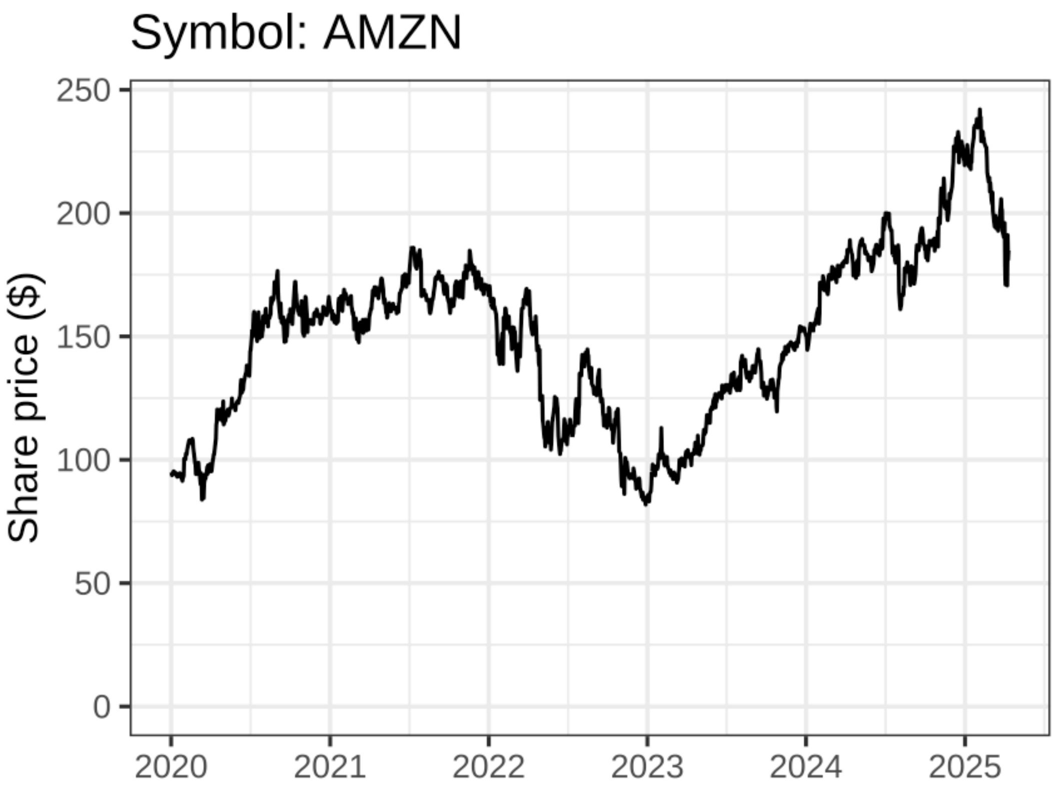


str_glue() allows us to put the contents of **ticker** in the plot's title

Step 1: Avoid hard-coding specific values

```
ticker <- "AMZN"

sp500_prices |>
  filter(symbol == ticker) |>
  ggplot(aes(x = date, y = adjusted)) +
  geom_line() +
  labs(x = NULL,
       y = "Share price ($)",
       title = str_glue("Symbol: {ticker}")) +
  scale_x_date(date_breaks = "1 year",
               date_labels = "%Y") +
  scale_y_continuous(limits = c(0, NA)) +
  theme_bw()
```



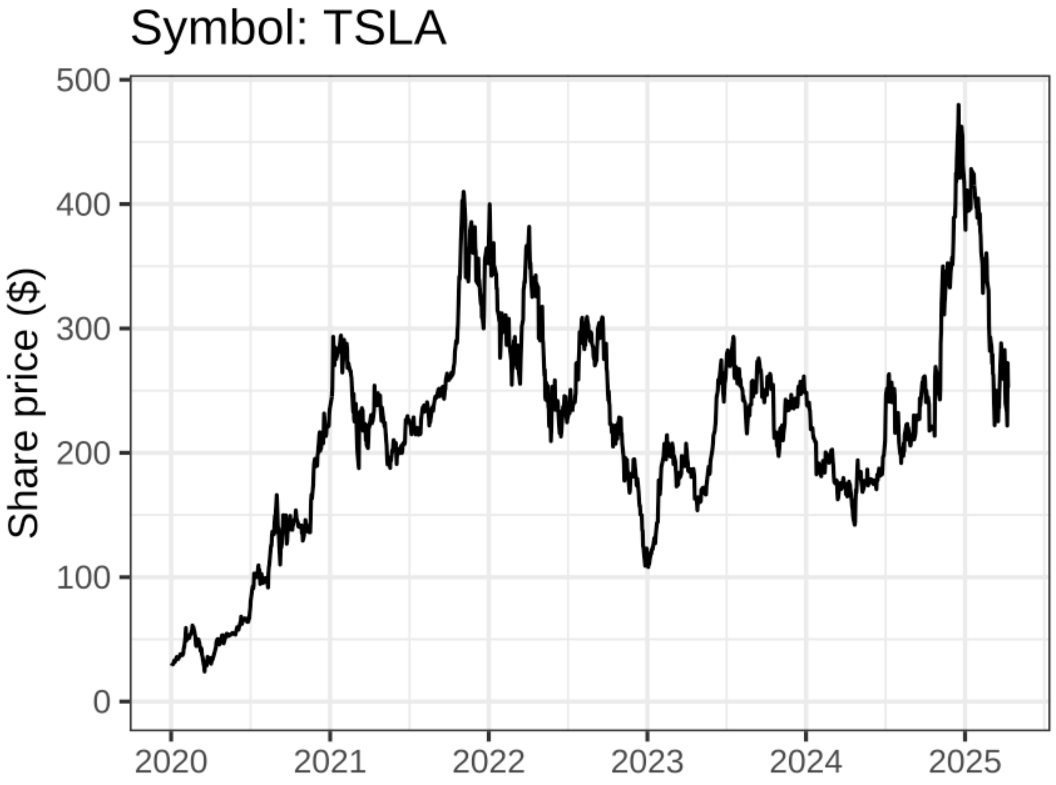
Now **ticker** is the only thing that changes

Step 1: Avoid hard-coding specific values

```r
ticker <- "TSLA"

sp500_prices |>
  filter(symbol == ticker) |>
  ggplot(aes(x = date, y = adjusted)) +
  geom_line() +
  labs(x = NULL,
       y = "Share price ($)",
       title = str_glue("Symbol: {ticker}")) +
  scale_x_date(date_breaks = "1 year",
               date_labels = "%Y") +
  scale_y_continuous(limits = c(0, NA)) +
  theme_bw()
```

Now **ticker** is the only thing that changes



Step 2: Define a function

```r
make_plot <- function(ticker) {
  sp500_prices |>
    filter(symbol == ticker) |>
    ggplot(aes(x = date, y = adjusted)) +
    geom_line() +
    labs(x = NULL,
         y = "Share price ($)",
         title = str_glue("Symbol: {ticker}")) +
    scale_x_date(date_breaks = "1 year",
                 date_labels = "%Y") +
    scale_y_continuous(limits = c(0, NA)) +
    theme_bw()
}
```

Three key steps:

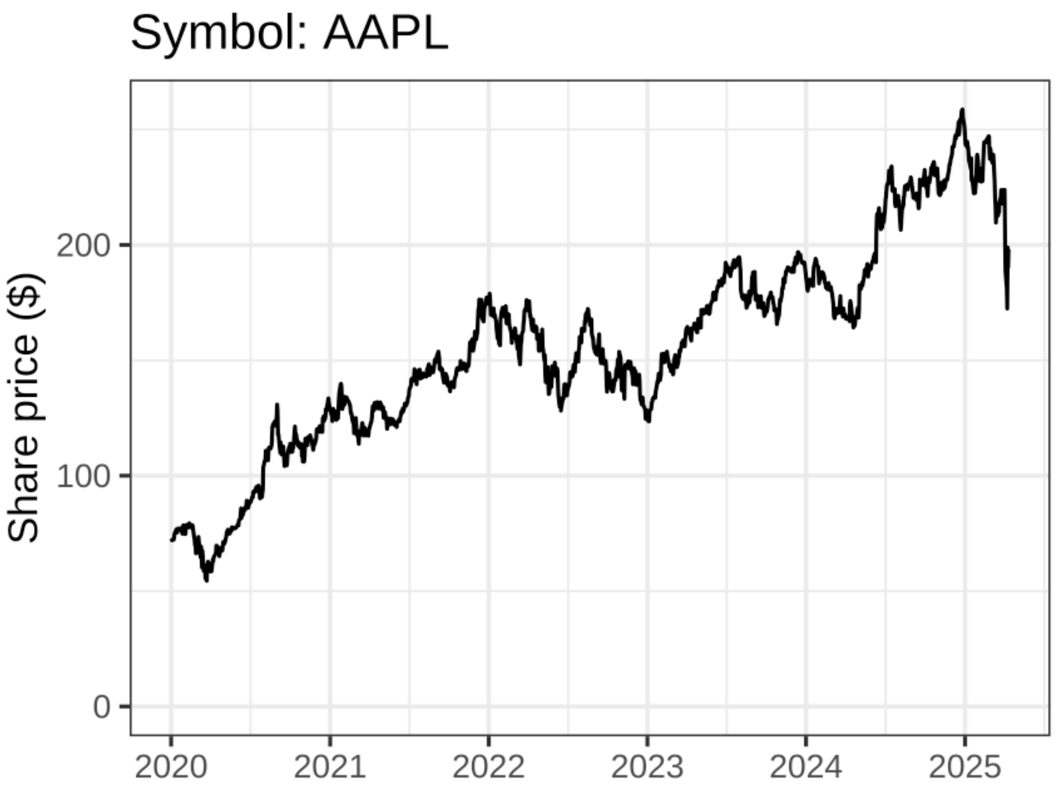
1. Pick a **name**
2. List **arguments** inside `function()`
3. Put code in the **body** of the function, delimited by `{...}`

Easiest to write the body on a test case, *then* convert it into a function

Step 2: Define a function

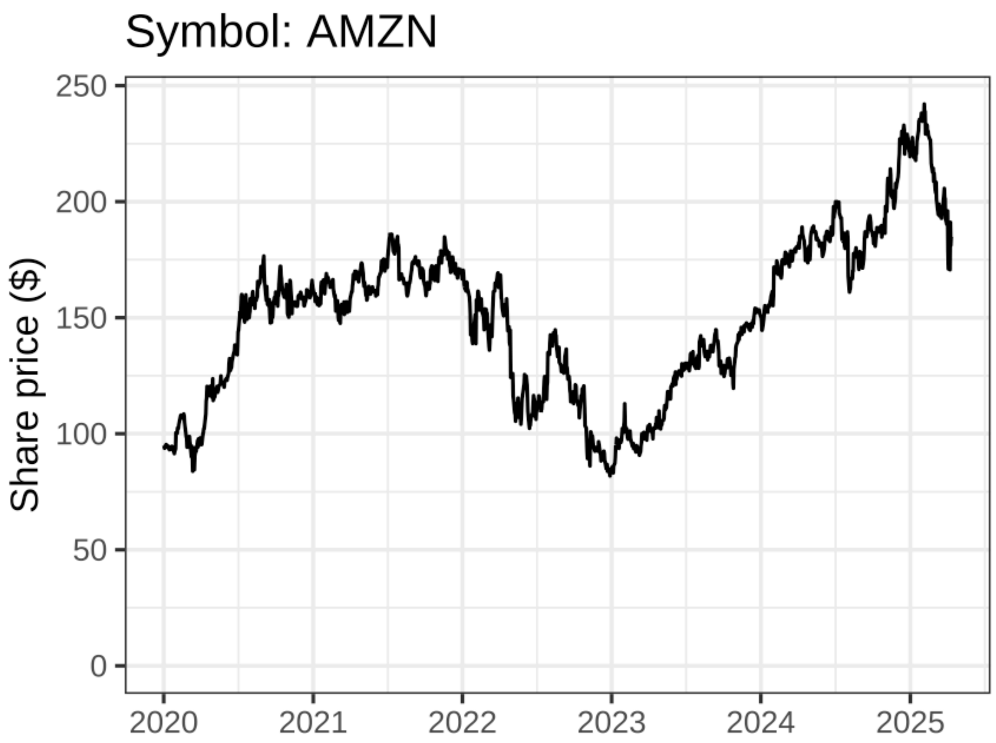
```r
make_plot <- function(ticker) {
  sp500_prices |>
    filter(symbol == ticker) |>
    ggplot(aes(x = date, y = adjusted)) +
    geom_line() +
    labs(x = NULL,
         y = "Share price ($)",
         title = str_glue("Symbol: {ticker}")) +
    scale_x_date(date_breaks = "1 year",
                 date_labels = "%Y") +
    scale_y_continuous(limits = c(0, NA)) +
    theme_bw()
}

make_plot("AAPL")
```

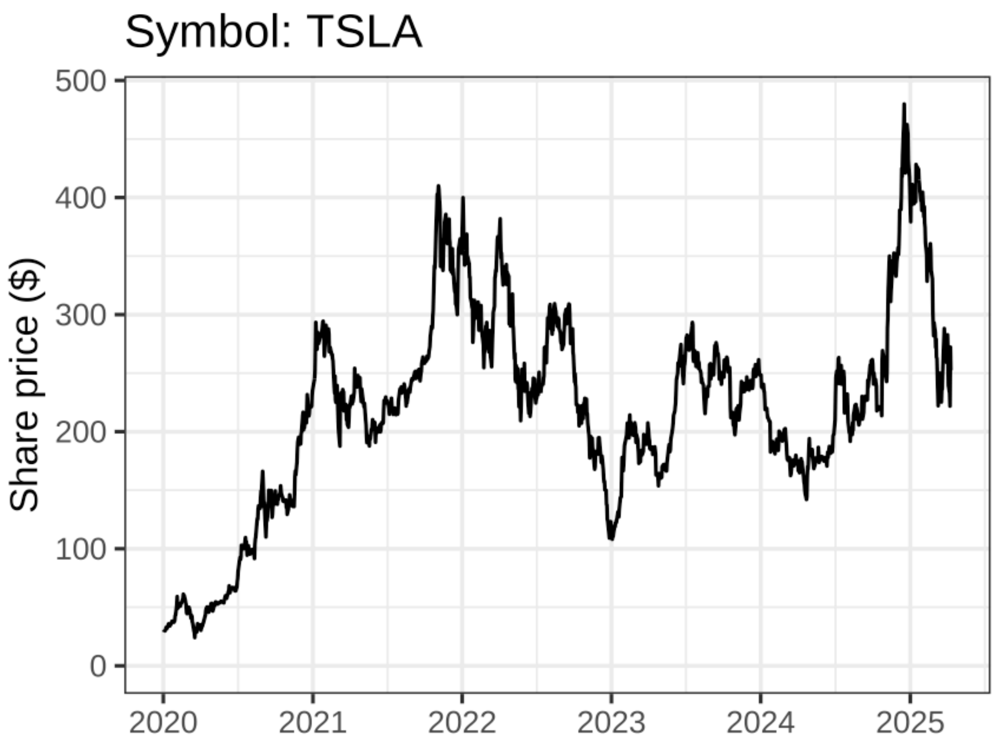


Step 2: Define a function

```
make_plot("AMZN")
```



```
make_plot("TSLA")
```



Rules of thumb about functions

- You can (almost) never write too many functions
- When you find yourself writing the same code 3+ times, put it into a function
- A function should be no longer than 20-40 lines
- If a function is getting too long, break it into smaller functions

Step 3: Automate calling the function

Individual function calls are hard to scale

```
make_plot("AAPL")
make_plot("AMZN")
make_plot("TSLA")
```

What if we wanted to make this plot for every company in the S&P 500?

How could you automate these function calls?

1. Imperative programming (for loops)

2. Functional programming (map functions)

Step 3: Automate calling the function

The `purrr` packages provides `map` functions that take a vector as input, apply a **function** to each element of the vector, and return the results in a new vector:

```
map(some_vector, some_function)
```

- `map` functions are basically identical to base R's `apply` functions

How can we use map to make plots for AAPL, AMZN, and TSLA?

```
symbols <- c("AAPL", "AMZN", "TSLA")
plots <- map(symbols, make_plot)
```

Here `map` takes each element of the vector `symbols` and uses it as input for our function `make_plot()`

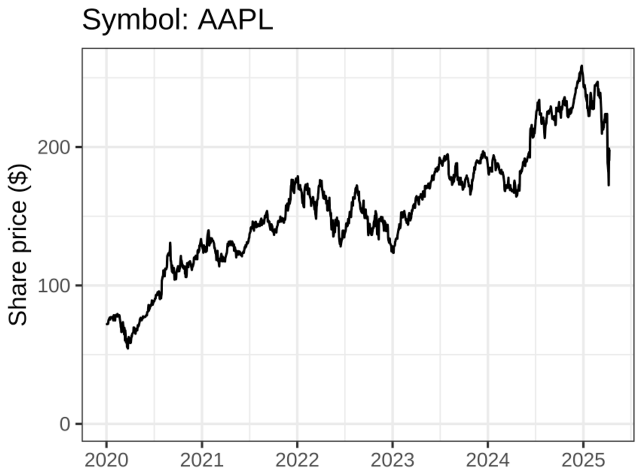
Step 3: Automate calling the function

`map` returns a **list**. In this example, it's a list of plots that we assigned to `plots`:

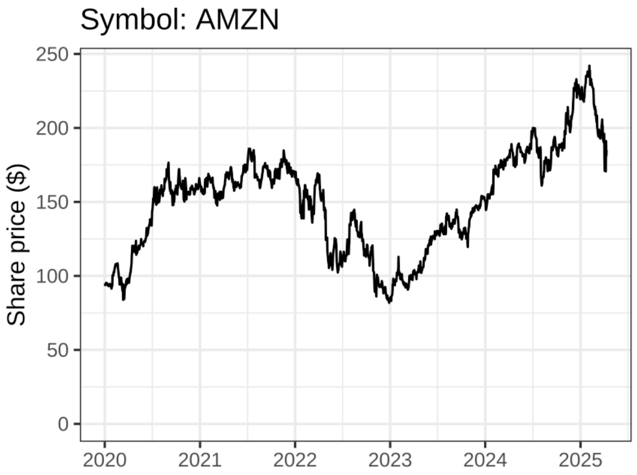
```
class(plots)
```

```
## [1] "list"
```

```
plots[[1]]
```



```
plots[[2]]
```



The syntax `plots[[x]]` allows us to drill down into the list `plots` and extract whatever object is in the `x`th position (here: a ggplot)

Step 3: Automate calling the function

This scales really easily!

```
all_symbols <- sp500_prices |> distinct(symbol) |> pull() # get all the symbols in the S&P 500
all_plots <- map(all_symbols, make_plot) # make a plot for each of the symbols
```

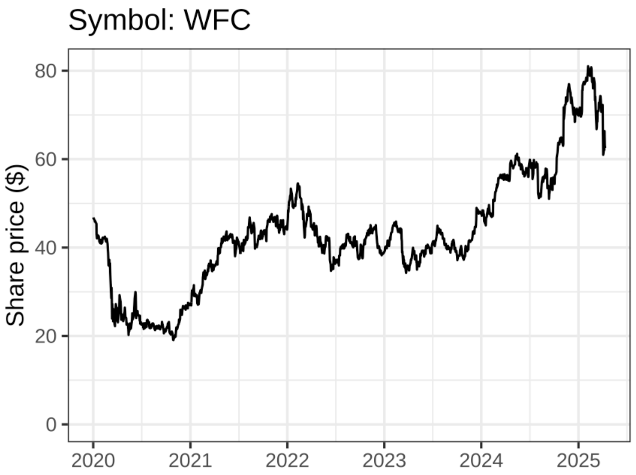
```
length(all_symbols)
```

```
## [1] 505
```

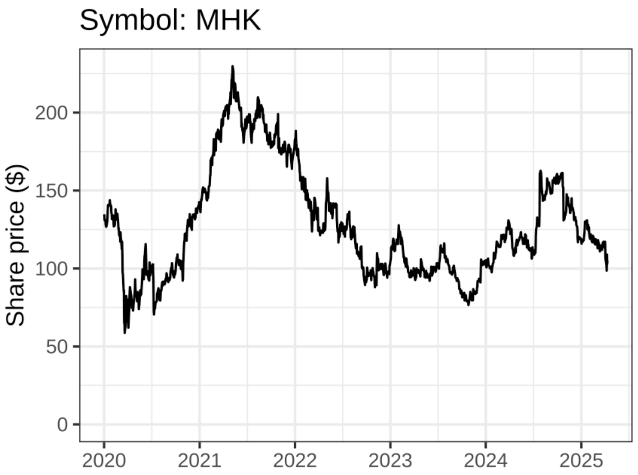
```
length(all_plots)
```

```
## [1] 505
```

```
all_plots[[35]]
```



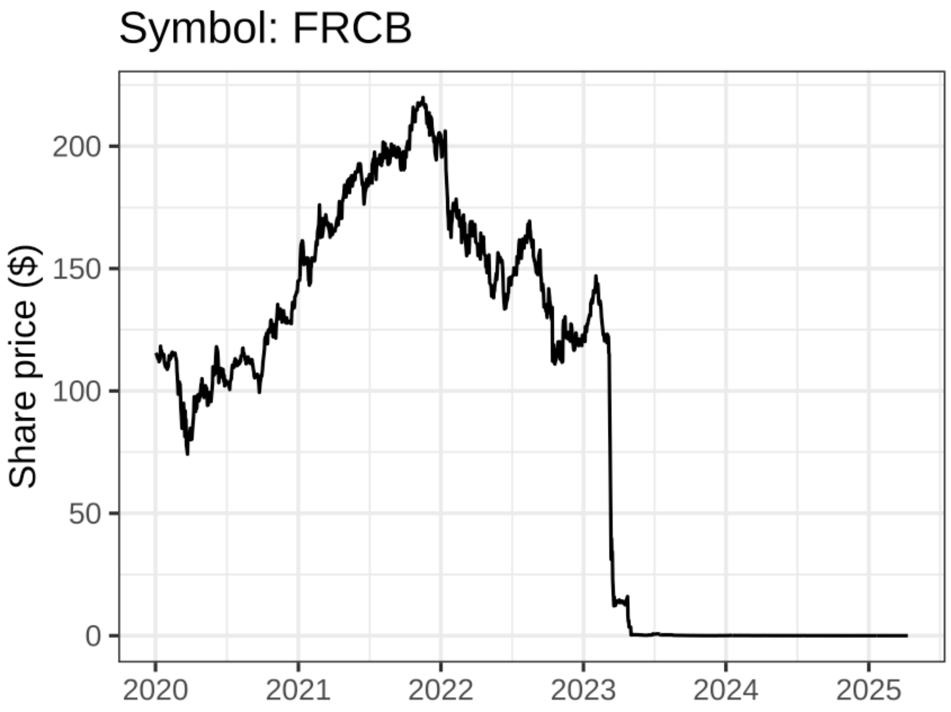
```
all_plots[[500]]
```



Step 3: Automate calling the function

We can also extract results using logical expressions:

```
all_plots[all_symbols=="FRCB"]
```



The map functions

The `purrr` package provides a family of `map` functions that return different types of output:

- `map()` makes a list
- `map_lgl()` makes a logical vector
- `map_int()` makes an integer vector
- `map_dbl()` makes a double vector
- `map_chr()` makes a character vector

What about `for` loops?

For loops work too!

```r
symbols <- c("AAPL", "AMZN", "TSLA")
plots <- vector("list", length(symbols)) # 1. allocate space for output
for (i in seq_along(symbols)) {          # 2. specify the sequence to loop over
  plots[[i]] <- make_plot(symbols[i])    # 3. specify what to do in each iteration
}
```

But functional programming is more concise:

```r
symbols <- c("AAPL", "AMZN", "TSLA")
plots <- map(symbols, make_plot)
```

Why not use `for` loops?

- They often require us to think about data logistics (indexing)
- They encourage iterative thinking over conceptual thinking
- Typically require more code, which often means more errors
- Can be harder to parallelize or otherwise optimize

But there is nothing wrong with using them!

We can practice using `for` loops during the example if time permits

example-12

Conditional execution

Functions with multiple arguments

homework-12