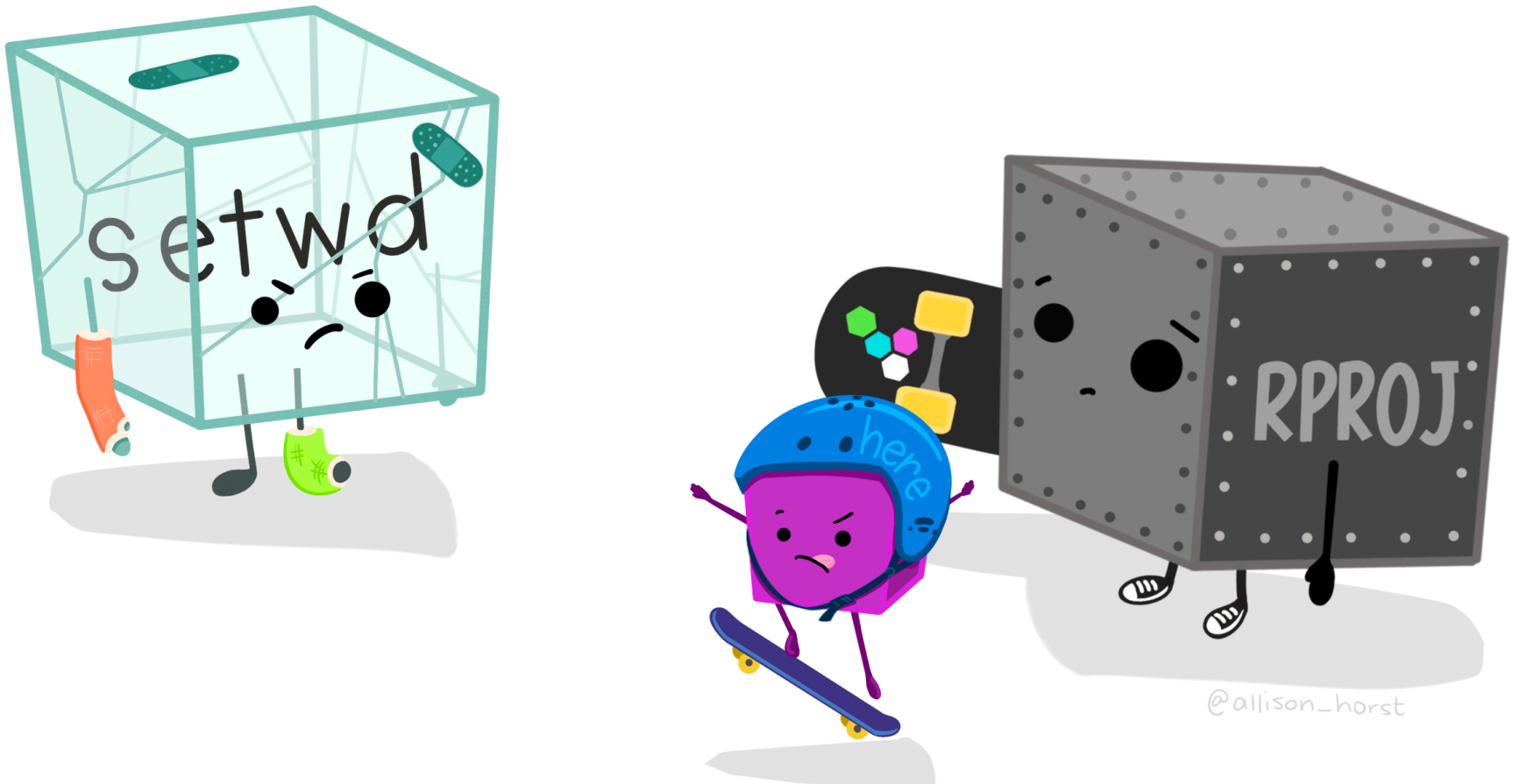
Code pipelines in R

Managing code with targets

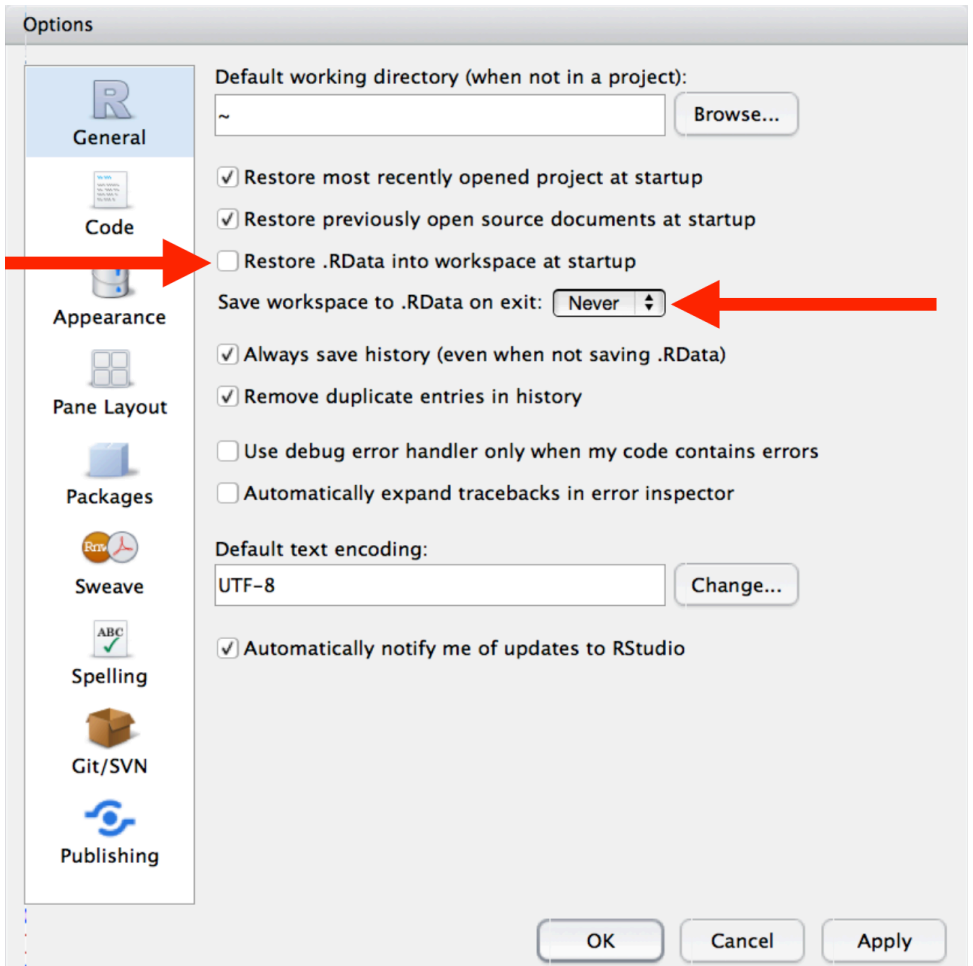
2025-03-23

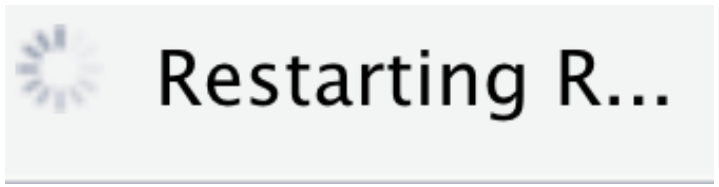
Strategies for reproduciblity



Project-Oriented Workflows

Strategies for reproduciblity





Use a clean slate; Restart early & often

Strategies for reproduciblity

- **Quarto** for reproducible documents
- **renv** for package version management
- **git/GitHub** for version control

Script-oriented workflows

```
01-read-data.R
02-clean-data.R
03-decriptive-stats.R
...
n-output.R
report.qmd
```

- Doesn't scale well—in terms of both time and scope

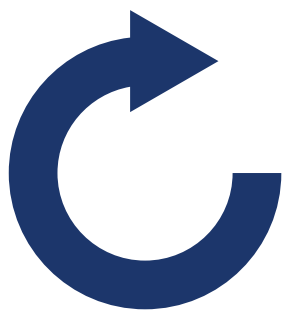
- Not clear what we can skip

Function-oriented workflows

```
source("functions.R")
data <- read_data("data.csv") |>
  clean_data()
table1 <- create_table(data)
...
ggsave("figure3.png")
rmarkdown::render("report.qmd")
```

Scale the work you need.

Skip the work you don't.



See evidence of reproducibility.

Setting up a pipeline

- targets requires a `_targets.R` file in the root directory of your project

- Create it with `tar_script()`; open it with `tar_edit()`

_targets.R

```
1  library(targets)
2  options(tidyverse.quiet = TRUE)
3  tar_option_set(packages = "tidyverse")
4  source("R/functions.R")
5
6  list(
7    tar_target(gapminder_file, "gapminder.csv", format = "file"),
8    tar_target(gapminder, read_csv(gapminder_file, col_types = col
9    tar_target(plot, create_line_plot(gapminder))
10 )
```

`functions.R` is common for small projects, but targets doesn't care how or from where you source functions.

R/functions.R

```r
create_line_plot <- function(gapminder) {
  gapminder |>
    filter(continent != "Oceania") |>
    ggplot(aes(x = year, y = lifeExp, group = country, color = c
    geom_line(lwd = 1, show.legend = FALSE) +
    facet_wrap(~ continent) +
    theme_minimal(14) +
    theme(strip.text = element_text(size = rel(1.1)))
}
```

_targets.R

```
1  library(targets)
2  options(tidyverse.quiet = TRUE)
3  tar_option_set(packages = "tidyverse")
4  source("R/functions.R")
5
6  list(
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8    tar_target(gapminder, read_csv(gapminder_file, col_types = col
9    tar_target(plot, create_line_plot(gapminder))
10 )
```
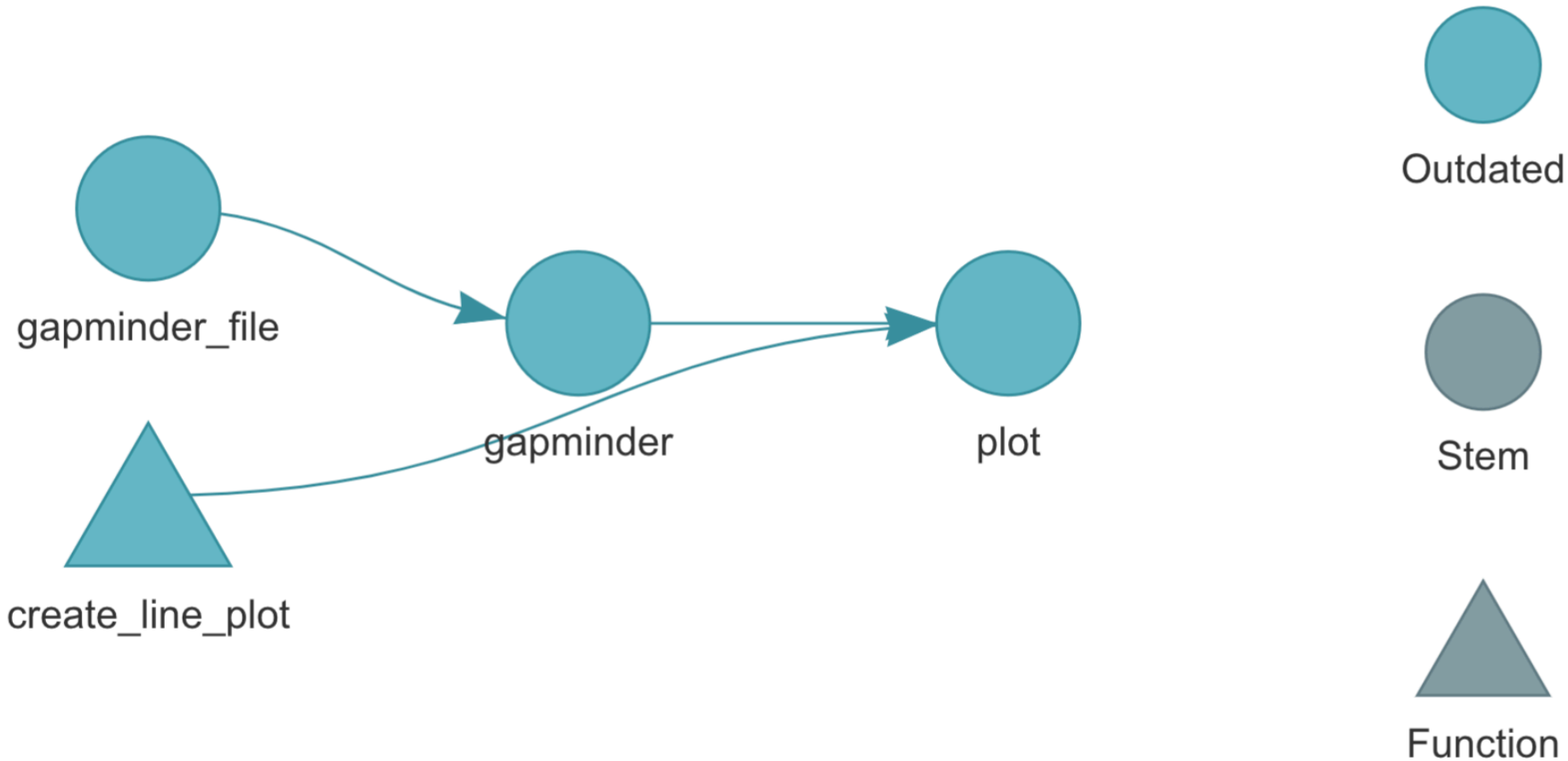

_targets.R **must** end in a list of targets

`tar_visnetwork()`



Run this **in the console**! Don't put it in `_targets.R` or other scripts.

_targets.R

```
1  library(targets)
2  options(tidyverse.quiet = TRUE)
3  tar_option_set(packages = "tidyverse")
4  source("R/functions.R")
5
6  list(
7    tar_target(gapminder_file, "gapminder.csv", format = "file"),
8    tar_target(gapminder, read_csv(gapminder_file, col_types = col
9    tar_target(plot, create_line_plot(gapminder))
10 )
```

Building the pipeline

```
1 tar_make()
```

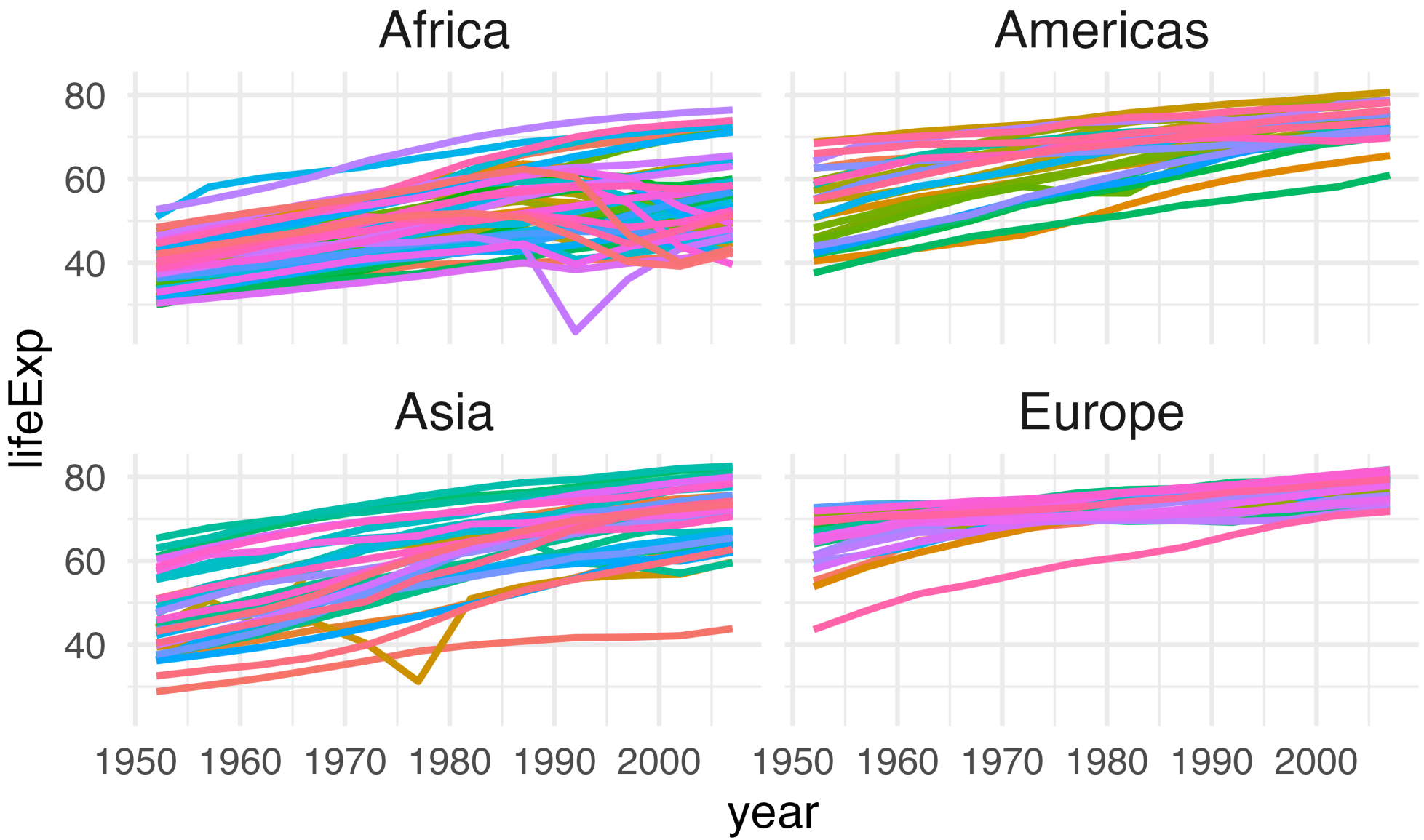
- start target gapminder_file
- built target gapminder_file
- start target gapminder
- built target gapminder
- start target plot
- built target plot
- end pipeline

Run this **in the console**! Don't put it in `_targets.R` or other scripts.

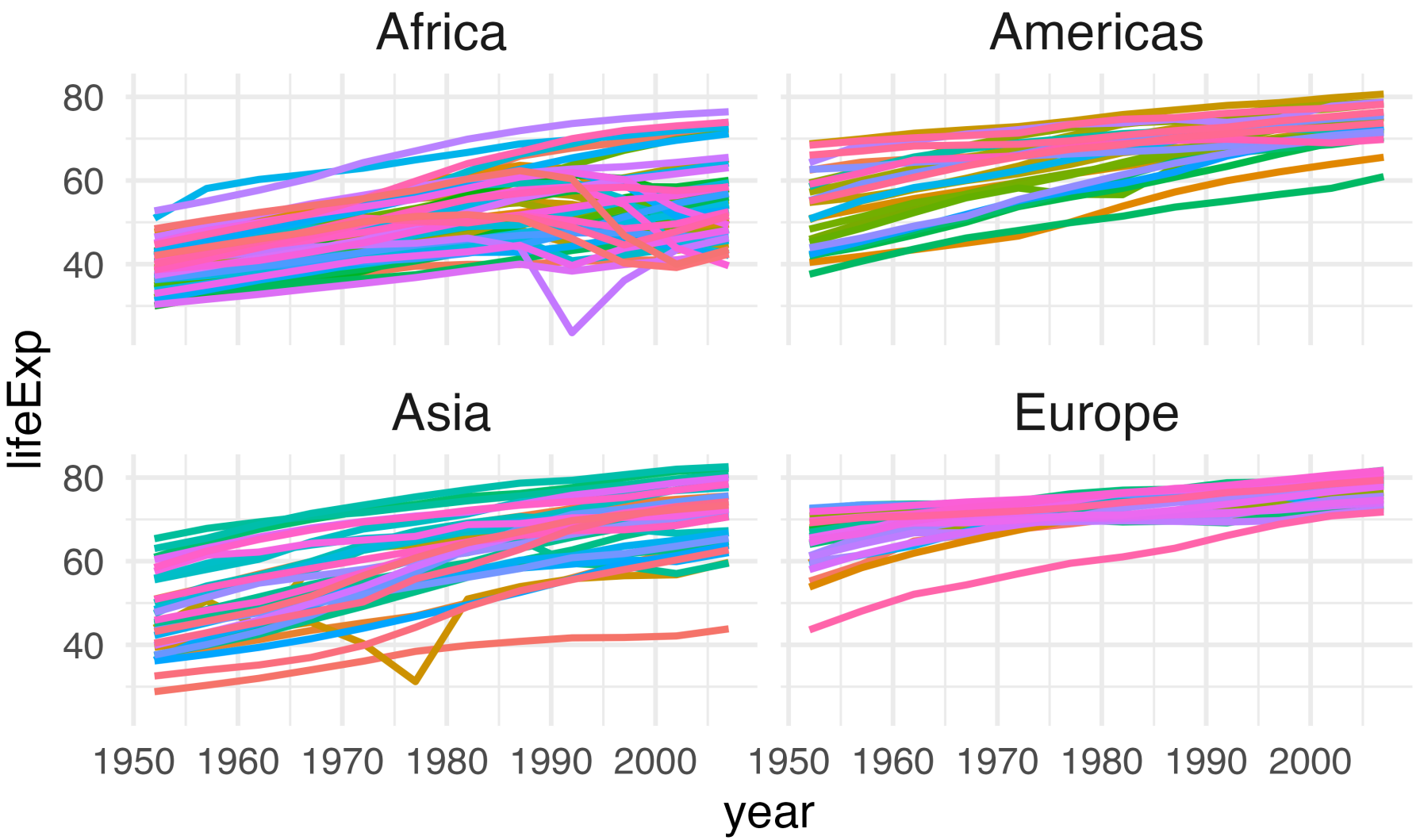
Where's my output?

- `tar_read(target_name)`: return target results
- `tar_load(target_name)`: load `target_name` into global environment

```
1 tar_read(plot)
```

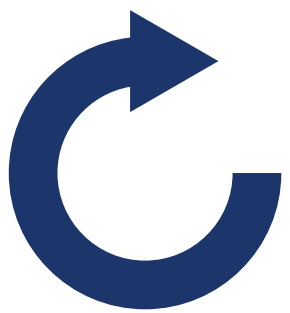


```
tar_load(plot)

plot
```



Scale the work you need.

Skip the work you don't.



See evidence of reproducibility.

Your Turn 1

Use `tar_script()` in the console, then open `_targets.R` (you can also use `tar_edit()` in the console to open it for you). Read the resulting script.

Predict how many targets there are, what they are called, and any other dependencies in your code. Run `tar_visnetwork()` in the console to check if you were right.

Run `tar_make()` in the console, then run `tar_visnetwork()` again. What's different? Try running `tar_make()` again.

Building our mental model

```
1 tar_target(plot, create_line_plot(gapminder))
```

Building our mental model

```
1 plot <- create_line_plot(gapminder)
```

Building our mental model

```
list(
  plot = create_line_plot(gapminder)
)
```

`tarchetypes`

- Collection of target and pipeline archetypes for targets
- Express complicated pipelines with concise syntax
- Need to include `library(tarchetypes)` in `_targets.R`

Plans

```
list(
  tar_target(gapminder_file, "gapminder.csv", format = "file"),
  tar_target(gapminder, read_csv(gapminder_file, col_types = col
  tar_target(plot, create_line_plot(gapminder))
)
```

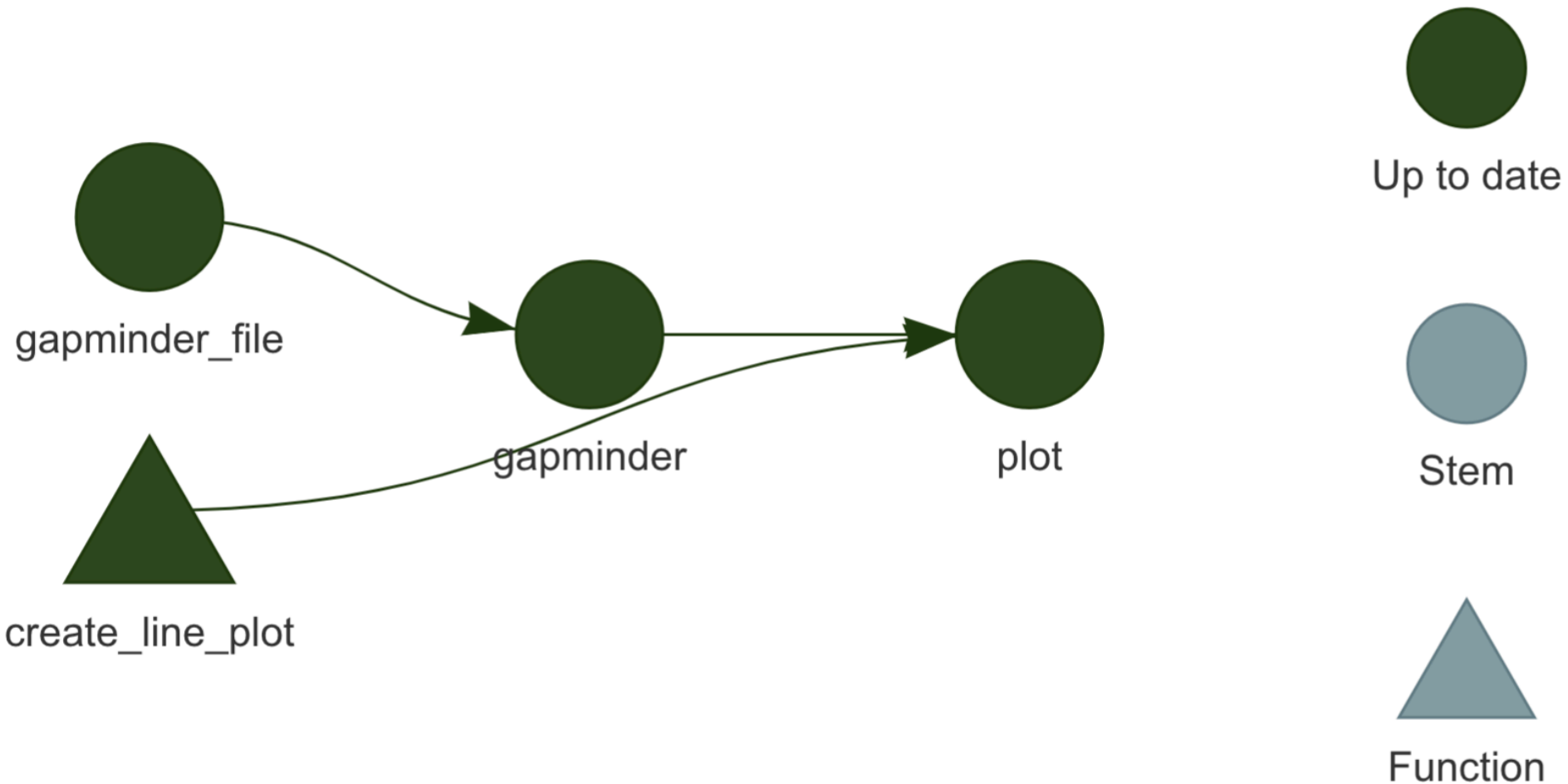
Plans

```
tar_plan(
  tar_target(gapminder_file, "gapminder.csv", format = "file"),
  tar_target(gapminder, read_csv(gapminder_file, col_types = col
  tar_target(plot, create_line_plot(gapminder))
)
```

Plans

```
tar_plan(
  tar_target(gapminder_file, "gapminder.csv", format = "file"),
  gapminder = read_csv(gapminder_file, col_types = cols()),
  plot = create_line_plot(gapminder)
)
```

tar_visnetwork()



Files

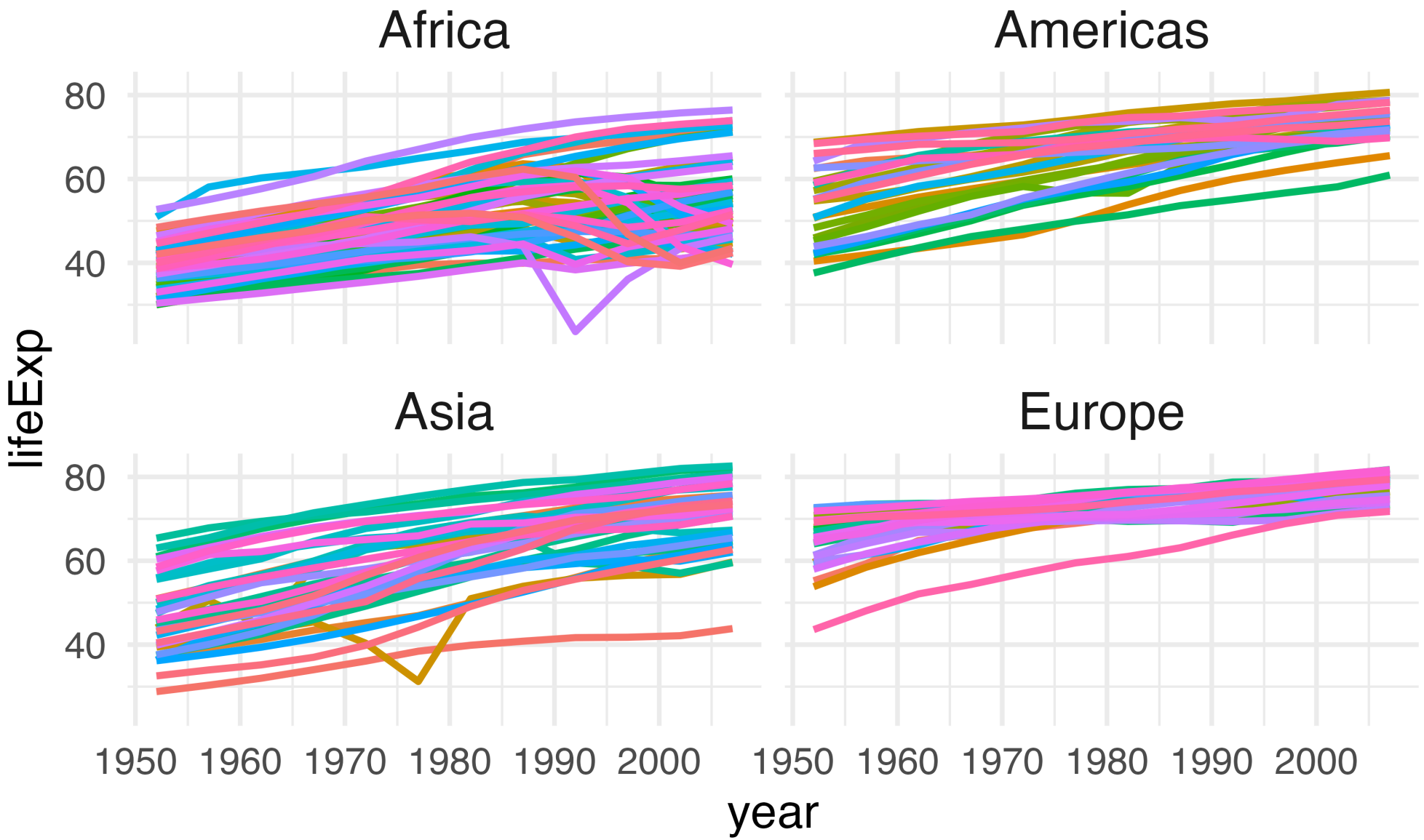
```
tar_plan(
  tar_file(gapminder_file, "gapminder.csv"),
  gapminder = read_csv(gapminder_file, col_types = cols()),
  plot = create_line_plot(gapminder)
)
```

See also `tar_url()`, `tar_parquet()`, and other file formats

Your Turn 2

Work through Your Turn 2 in `exercises.qmd`

```
1 tar_read(plot)
```

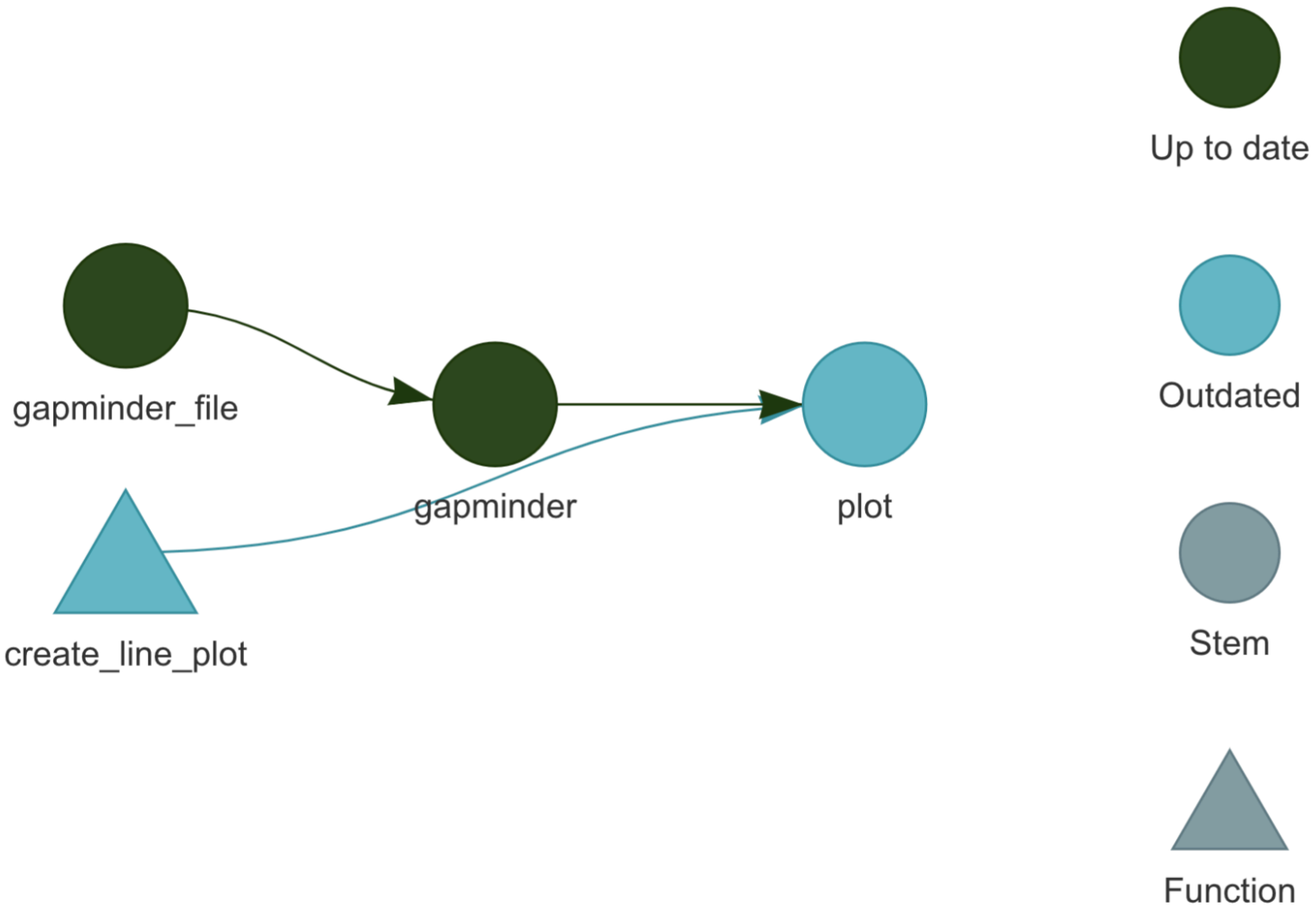


```r
create_line_plot <- function(gapminder) {
  gapminder |>
    filter(continent != "Oceania") |>
    ggplot(aes(
      x = year,
      y = lifeExp,
      group = country,
      color = country
    )) +
    geom_line(lwd = 1, show.legend = FALSE) +
    facet_wrap(~ continent) +
    scale_color_manual(values = country_colors) +
    theme_minimal(14) +
    theme(strip.text = element_text(size = rel(1.1)))
}
```

_targets.R

```
library(targets)
library(tarchetypes)
options(tidyverse.quiet = TRUE)
tar_option_set(packages = c("tidyverse", "gapminder"))
source("R/functions.R")

tar_plan(
  tar_file(gapminder_file, "gapminder.csv"),
  gapminder = read_csv(gapminder_file, col_types = cols()),
  plot = create_line_plot(gapminder)
)
```

tar_visnetwork()



Outdated targets

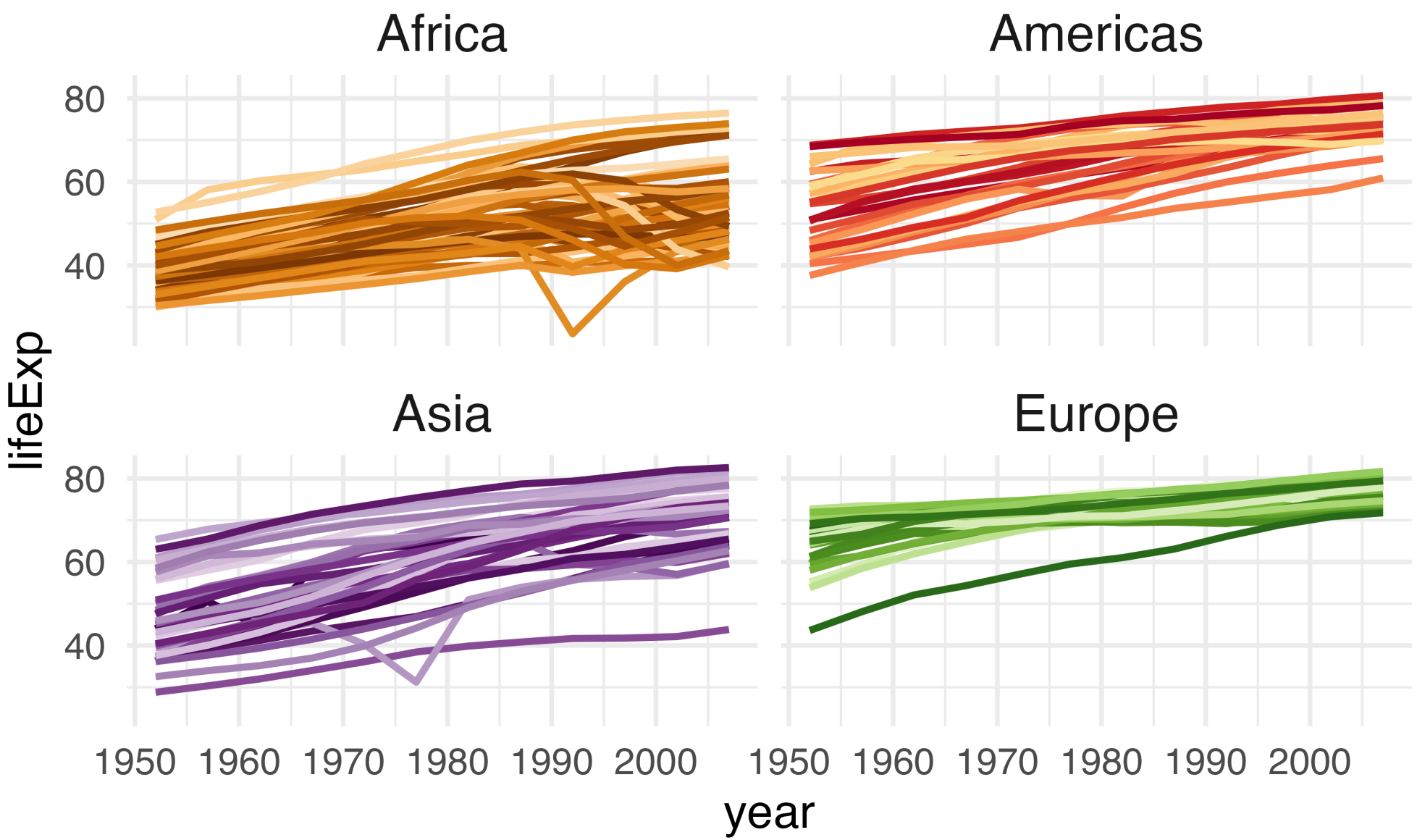
```
1 tar_outdated()
```

```
[1] "plot"
```

tar_make()

```
✓ skip target gapminder_file
✓ skip target gapminder
• start target plot
• built target plot
• end pipeline
```

```
1 tar_read(plot)
```



Your Turn 3

Change `diabetes_file` to use `diabetes.csv` instead

Run `tar_outdated()` in the console. What's this telling you? Confirm with `tar_visnetwork()`

Predict which targets are going to re-run, then run `tar_make()`. Were you right?

Confirm that `diabetes` has changed by looking at it with `tar_read()`. The new dataset should have 403 rows and 20 columns.

Building up your pipeline

- *Good targets are meaningful units of your analysis or important dependencies like files*
- *Add one or two targets at a time*
- *Run `tar_make()` and `tar_visnetwork()` often*
- *Load all targets: `tar_load(everything())`*

Organizing your functions

- `functions.R` only works well for small pipelines, but targets doesn't have a preference for you organize them

> While you're free to arrange functions into files as you wish, [avoid] the two extremes… don't put all functions into one file and don't put each function into its own separate file. —R Packages, 2nd Ed.

What I like to do

1. Create an *R/* folder
2. Create and open new files in R/ with *use_r("file_name")* from the usethis package
3. In _targets.R: *purrr::walk(fs::dir_ls("R"), source)*

Your Turn 4

Add `source("R/functions.R")` to `_targets.R`

Add "gtsummary" to the `packages` argument of `tar_option_set()`

Create a new target called `table_one` using `create_table_one(diabetes)`

Run `tar_visnetwork()` and `tar_make()`

Take a look at the target you just created

Your Turn 5

Open `R/functions.R` and modify `create_table_one()`: Add the argument `missing_text = "(Missing)"` to `tbl_summary()`. Make sure to save your file after you've made the change.

Run `tar_outdated()` in the console, then look at `tar_visnetwork()`

Predict which targets are going to re-run, then run `tar_make()`. Were you right?

Including Quarto files as targets

1. Create a Quarto file
2. Use `tar_read()` or `tar_load()` in the `.qmd` file to access targets
3. Include `tar_quarto(target_name, "file_name.qmd")` in your list of targets

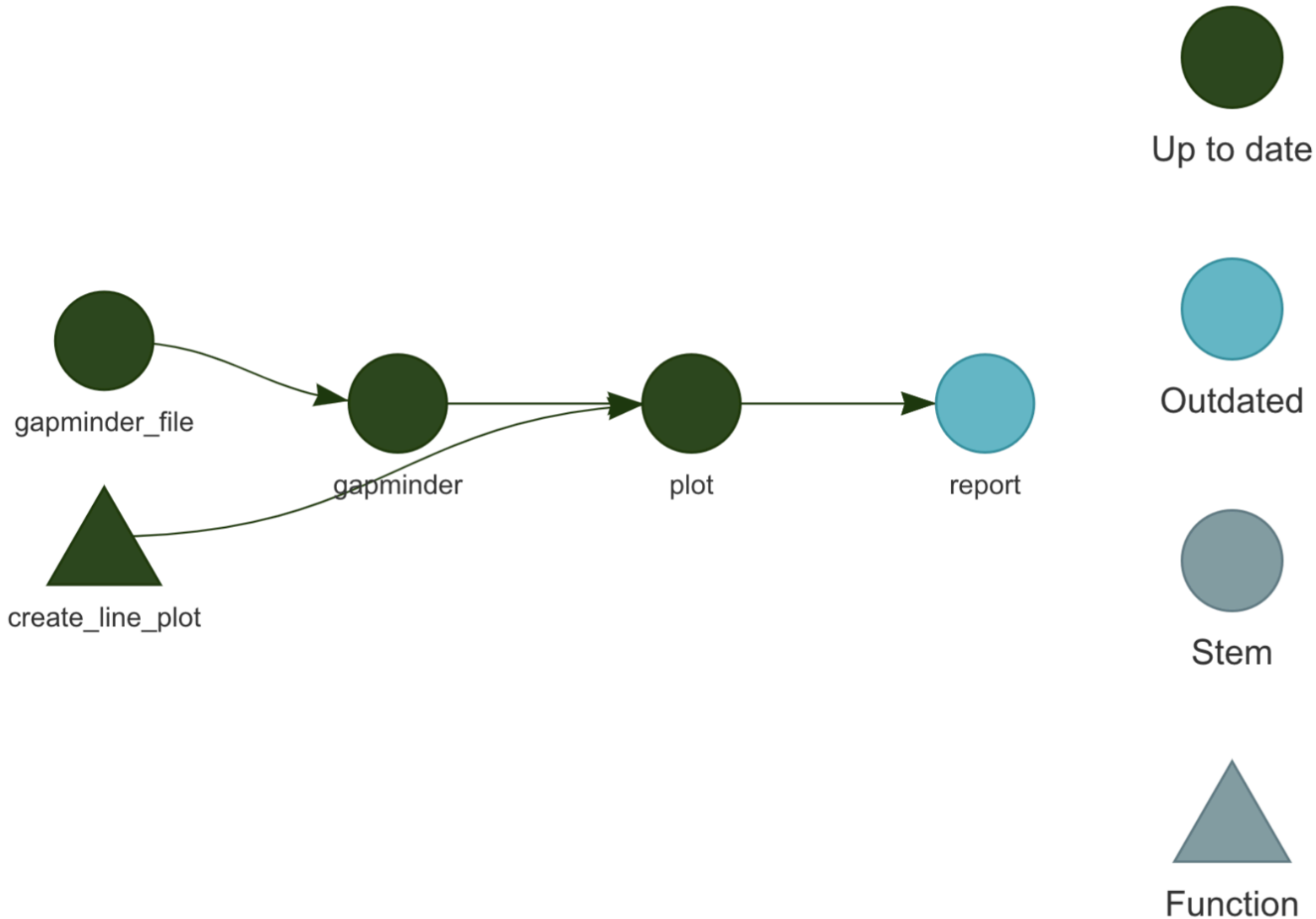
report.qmd

````
```{r}
#| label: setup
#| echo: false
library(targets)

tar_load(gapminder)
```

These data have `r nrow(gapminder)` observations.

```{r}
label: fig-one
tar_read(plot)
```
````

_targets.R

```r
library(targets)
library(tarchetypes)
options(tidyverse.quiet = TRUE)
tar_option_set(packages = c("tidyverse", "gapminder"))
source("R/functions.R")

tar_plan(
  tar_file(gapminder_file, "gapminder.csv"),
  gapminder = read_csv(gapminder_file, col_types = cols()),
  plot = create_line_plot(gapminder),
  tar_quarto(report, "report.qmd")
)
```

tar_visnetwork()



tar_make()

```
✓ skip target gapminder_file
✓ skip target gapminder
✓ skip target plot
• start target report
• built target report
• end pipeline
```

Your Turn 6

Work through Your Turn 6 in `exercises.qmd`

The targets cache: `_targets/`

- `tar_destroy()`: Remove everything in the cache
- `tar_prune()`: Remove targets that are no longer part of the pipeline

Your Turn 7

Confirm that you can reproduce your entire pipeline from scratch. In the console:

Run `tar_destroy()`

Run `tar_make()`

Automatic parallelization

_targets.R

```
# --snip--
library(crew)
n_cores <- 4
tar_option_set(
  controller = crew_controller_local(workers = n_cores)
)
# --snip--
```

See crew.cluster for Slurm and other HPC support controllers

Branching

```
list(
  tar_files(
    csv_files,
    fs::dir_ls("data", regexp = "\\.csv$")
  ),
  tar_target(
    parquet_files,
    convert_csv_to_parquet(csv_files),
    pattern = map(csv_files)
  )
)
```

Resources

The targets User Manual: A comprehensive but friendly introduction to targets. Free online.

The Official targets Short Course: A free short course available on Posit Cloud or locally

Talks and other targets resources