

# ETC4500/ETC5450

## Advanced R programming

Week 5: Reactive programming with  
targets and renv



# Outline

- 1 targets
- 2 Reproducible environments

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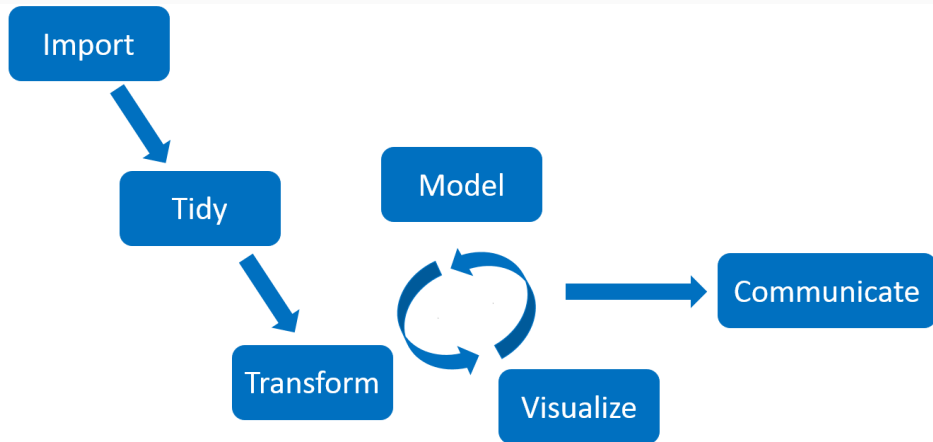
- 1 targets
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# targets: reproducible computation at scale

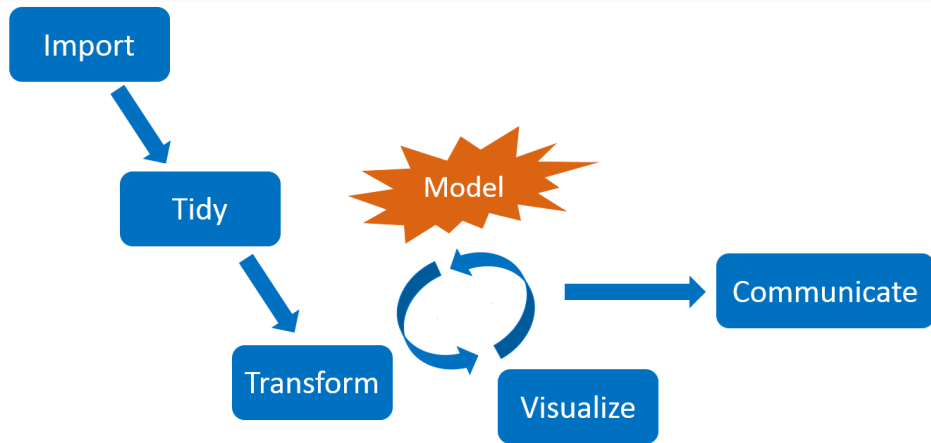


- Supports a clean, modular, function-oriented programming style.
- Learns how your pipeline fits together.
- Runs only the necessary computation.
- Abstracts files as R objects.
- Similar to Makefiles, but with R functions.

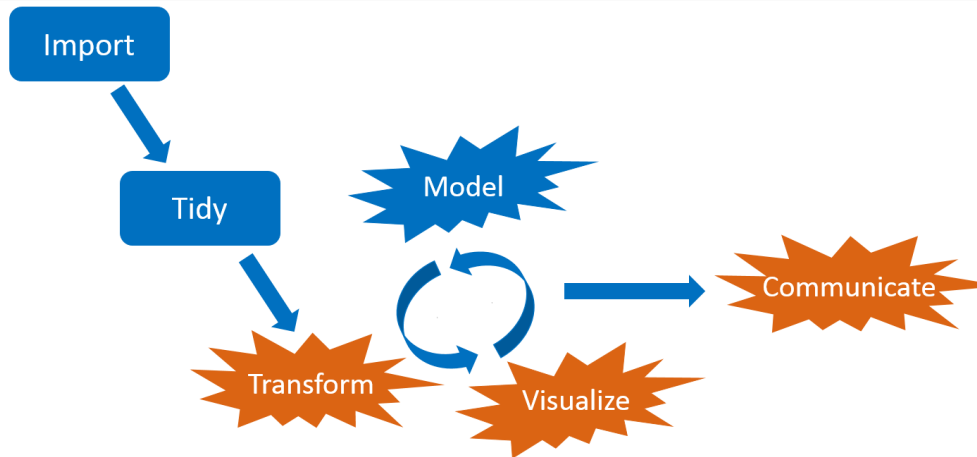
# Interconnected tasks



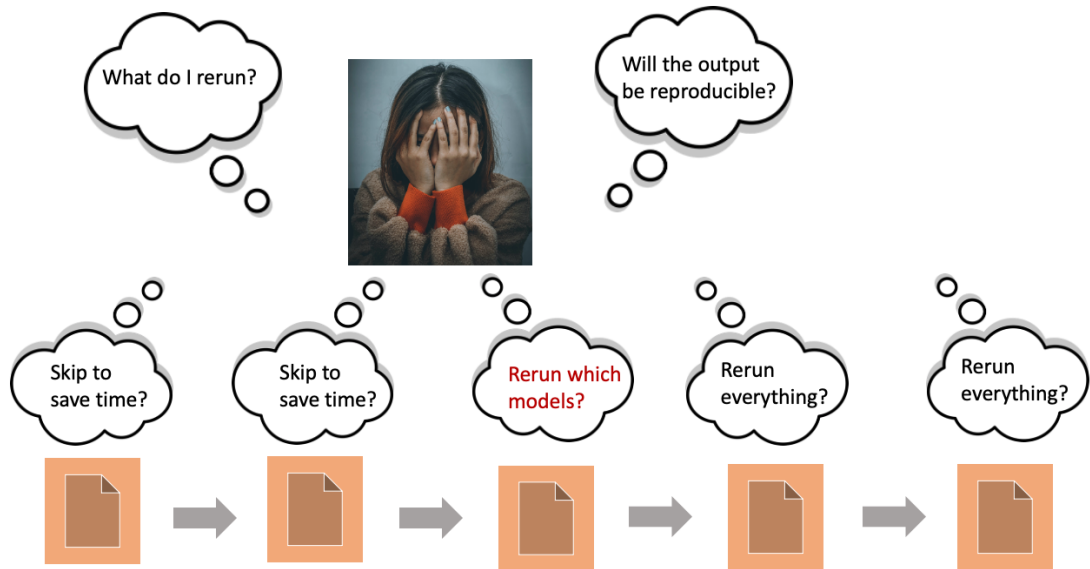
# Interconnected tasks



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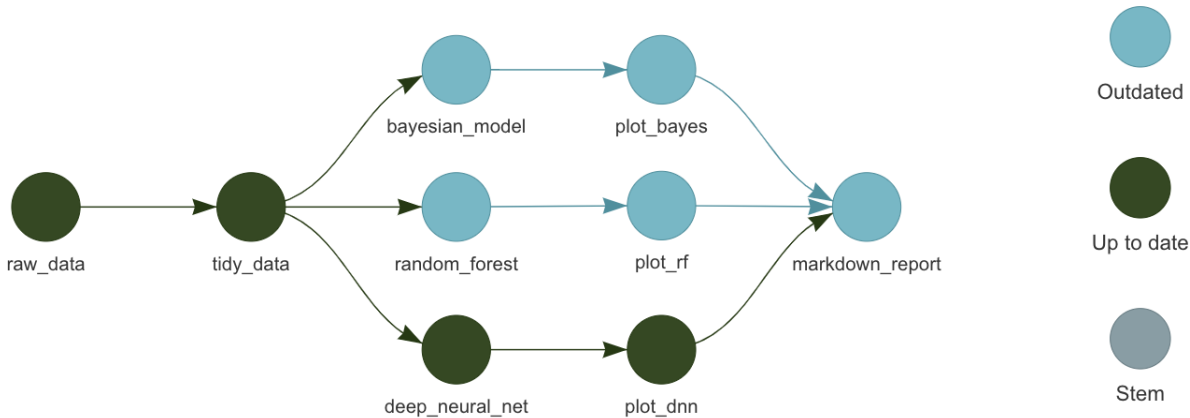


# Dilemma: short runtimes or reproducible results?





# Let a pipeline tool do the work



- Save time while ensuring computational reproducibility.
- Automatically skip tasks that are already up to date.

# Typical project structure

```
_targets.R # Required top-level configuration file.  
R/  
└─ functions.R  
data/  
└─ my_data.csv
```

## **\_targets.R**

```
library(targets)  
tar_source() # source all files in R folder  
tar_option_set(packages = c("tidyverse", "fable"))  
list(  
  tar_target(my_file, "data/my_data.csv", format = "file"),  
  tar_target(my_data, read_csv(my_file)),  
  tar_target(my_model, model_function(my_data))  
)
```

# Generate \_targets.R in working directory

```
library(targets)  
tar_script()
```

# Useful targets commands

- `tar_make()` to run the pipeline.
- `tar_make(starts_with("fig"))` to run only targets starting with “fig”.
- `tar_read(object)` to read a target.
- `tar_load(object)` to load a target.
- `tar_load_everything()` to load all targets.
- `tar_manifest()` to list all targets
- `tar_visnetwork()` to visualize the pipeline.
- `tar_destroy()` to remove all targets.
- `tar_outdated()` to list outdated targets.

# Debugging

Errored targets to return NULL so pipeline continues.

```
tar_option_set(error = "null")
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See error messages for all targets.

```
tar_meta(fields = error, complete_only = TRUE)
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# Debugging

Errored targets to return NULL so pipeline continues.

```
tar_option_set(error = "null")
```

See error messages for all targets.

```
tar_meta(fields = error, complete_only = TRUE)
```

See warning messages for all targets.

```
tar_meta(fields = warnings, complete_only = TRUE)
```

# Debugging

- Try loading all available targets: `tar_load_everything()`.  
Then run the command of the errored target in the console.
- Pause the pipeline with `browser()`
- Use the debug option: `tar_option_set(debug = "target_name")`
- Save the workspaces:
  - ▶ `tar_option_set(workspace_on_error = TRUE)`
  - ▶ `tar_workspaces()`
  - ▶ `tar_workspace(target_name)`



# Random numbers

- Each target runs with its own seed based on its name and the global seed from `tar_option_set(seed = ???)`
- So running only some targets, or running them in a different order, will not change the results.

# Folder structure

```
├── .git/
├── .Rprofile
├── .Renviron
├── renv/
├── index.Rmd
├── _targets/
├── _targets.R
├── _targets.yaml
├── R/
│   ├── functions_data.R
│   ├── functions_analysis.R
│   └── functions_visualization.R
├── data/
└── input_data.csv
```

# targets with quarto

```
library(targets)
library(tarchetypes)
tar_source() # source all files in R folder
tar_option_set(packages = c("tidyverse", "fable"))
list(
  tar_target(my_file, "data/my_data.csv", format = "file"),
  tar_target(my_data, read_csv(my_file)),
  tar_target(my_model, model_function(my_data))
  tar_quarto(report, "file.qmd", extra_files = "references.bib")
)
```

①

②

- ① Load tarchetypes package for quarto support.
- ② Add a quarto target.

# Exercise

- Add a targets workflow to your quarto document.
- Create a visualization of the pipeline network using `tar_visnetwork()`.

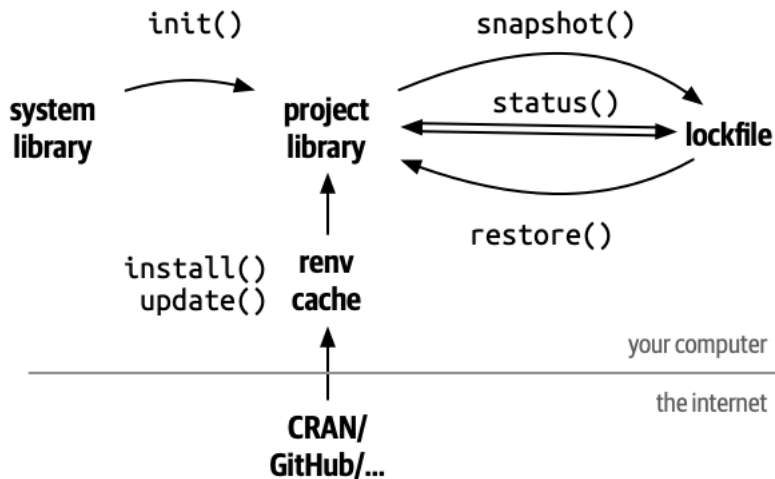
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# Reproducible environments

- To ensure that your code runs the same way on different machines and at different times, you need the computing environment to be the same.
  - 1 Operating system
  - 2 System components
  - 3 R version
  - 4 R packages
- Solutions for 1–4: Docker, Singularity, containerit, rang
- Solutions for 4: packrat, checkpoint, renv

# renv package



- `renv::init()` : initialize a new project with a new environment. Adds:
  - ▶ `renv/library` contains all packages used in project
  - ▶ `renv.lock` contains metadata about packages used in project
  - ▶ `.Rprofile` run every time R starts.
- `renv::snapshot()` : save the state of the project to `renv.lock`.
- `renv::restore()` : restore the project to the state saved in `renv.lock`.



# renv package

- `renv` uses a package cache so you are not repeatedly installing the same packages in multiple projects.
- `renv::install()` can install from CRAN, Bioconductor, GitHub, Gitlab, Bitbucket, etc.
- `renv::update()` gets latest versions of all dependencies from wherever they were installed from.
- Only R packages are supported, not system dependencies, and not R itself.
- `renv` is not a replacement for Docker or Singularity.
- `renv::deactivate(clean = TRUE)` will remove the `renv` environment.