

# Introduction to Data Science

## Session 14: Automation, scheduling, and packages

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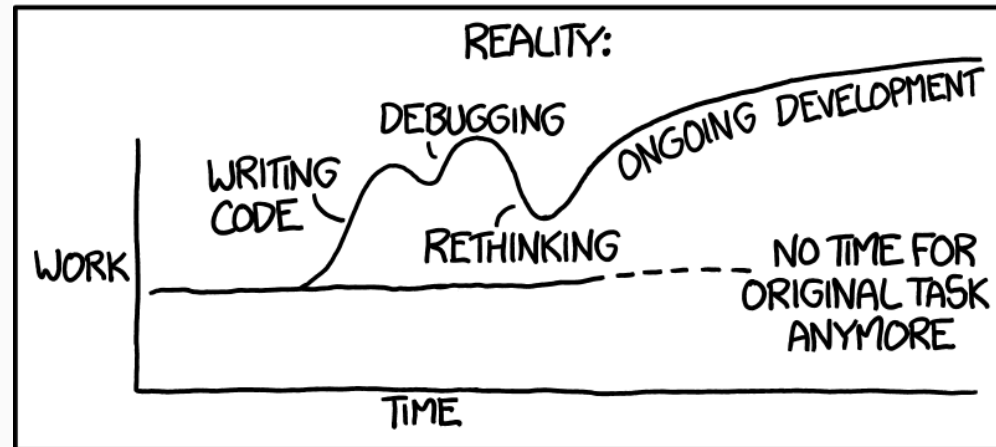
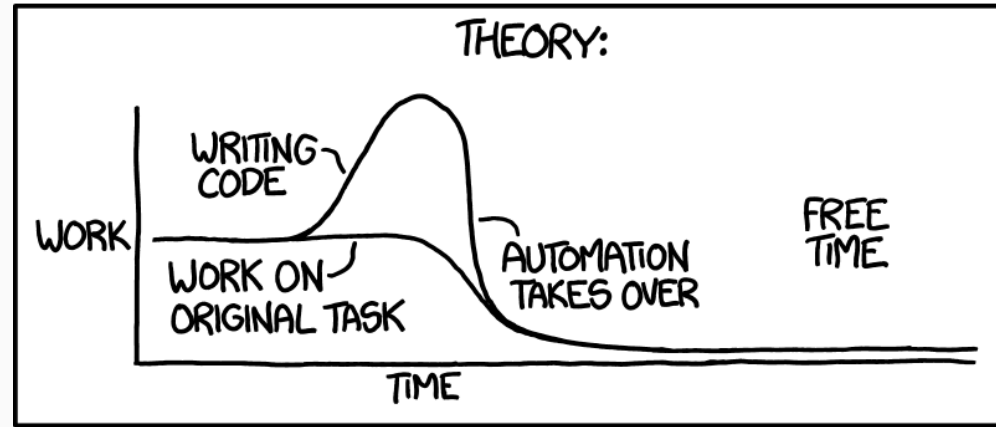
1. Automation and scripting
2. Scheduling
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# Automation and scripting

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# Automation

"I SPEND A LOT OF TIME ON THIS TASK.  
I SHOULD WRITE A PROGRAM AUTOMATING IT!"



Credit [Randall Munroe/xkcd 1319](#)

# Automation

## Motivation

- We spend **too much time** on repetitive tasks.
- We're already automating using scripts that bundle multiple commands! Next step: The pipeline as a series of scripts and commands.
- Good pipelines are modular. But you don't want to trigger 10 scripts sequentially by hand.
- Some tasks are to be repeated on a regular basis (schedule).

## When automation makes sense

- The input is variable but the process of turning input into output is highly standardized.
- You use a diverse set of software to produce the output.
- Others (humans, machines) are supposed to run the analyses.
- Time saved by automation >> Time needed to automate.

## Different ways of doing it

We will consider automation

# Thinking in pipelines

## Key characteristics

- Pipelines make complex projects easier to handle because they break up a monolithic script into **discrete, manageable chunks**.
- If properly done, each stage of the pipeline defines its input and its outputs.
- Pipeline modules **do not modify their inputs** (*idempotence*). Rerunning one module produces the same results as the previous run.

## Key advantages

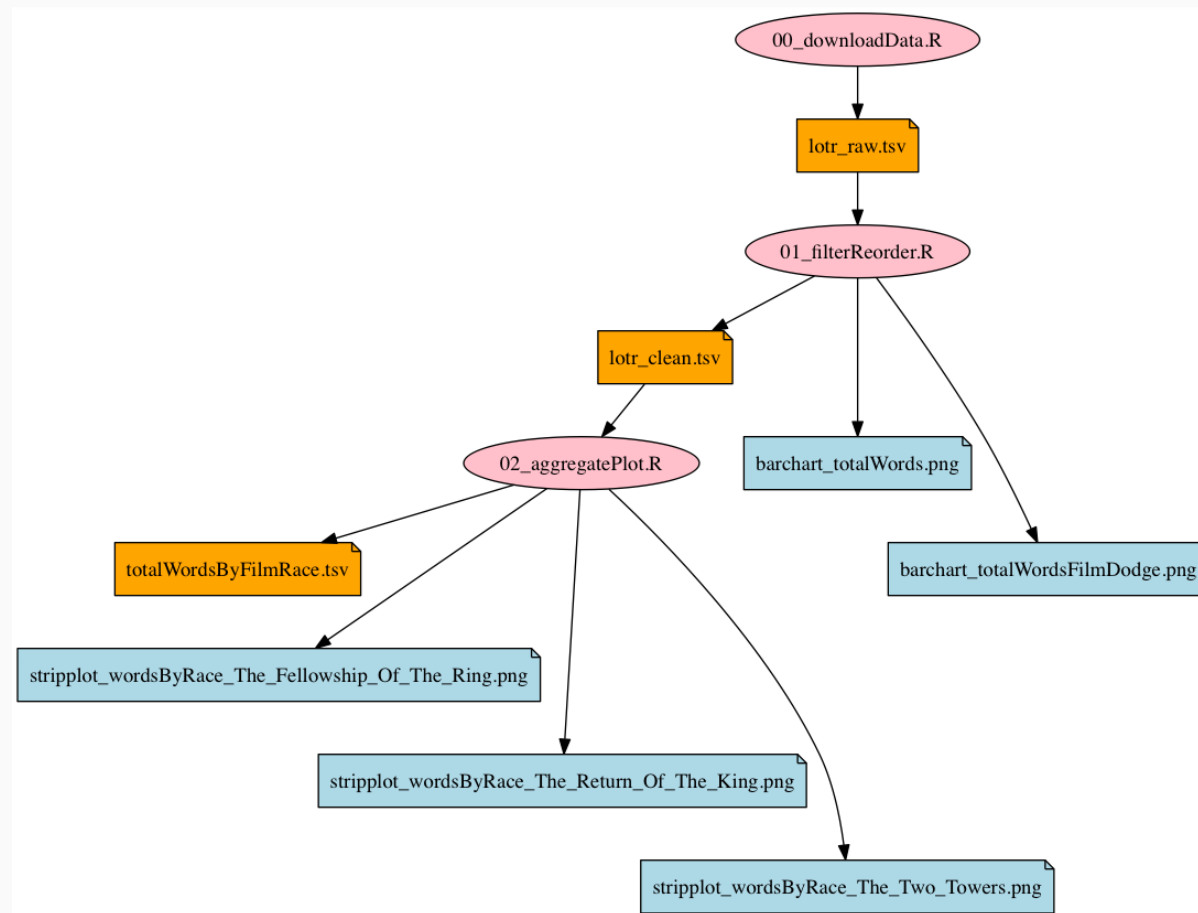
- When you modify one stage of the pipeline, you only have to rerun the downstream, dependent stages.
- Division of labor is straightforward.
- Modules tend to be a lot easier to debug.



# A data science pipeline is a graph

## Wait what

- Scripts and data files are vertices of the graph.
- Dependencies between stages are edges of the graph.
- Pipelines are not necessarily DAGs. Recursive routines are imaginable (but to be avoided?).
- Also, scripts are not necessarily hierarchical (e.g., multiple different modeling approaches of the same data in different scripts).
- An automation script gives *one* order in which you can successfully run the pipeline.



# An example pipeline

In the following, we will work with this toy pipeline:

<sup>1</sup>Courtesy of Jenny Bryan.



# An example pipeline

In the following, we will work with this toy pipeline:

- `00-packages.R` loads the packages necessary for analysis,

`00-packages.R`:

```
R> # install packages from CRAN
R> p_needed <- c("tidyverse" # tidyverse packages
+ )
R> packages <- rownames(installed.packages())
R> p_to_install <- p_needed[!(p_needed %in% packages)]
R> if (length(p_to_install) > 0) {
+   install.packages(p_to_install)
+ }
R> lapply(p_needed, require, character.only = TRUE)
```

# An example pipeline

In the following, we will work with this toy pipeline:

- `00-packages.R` loads the packages necessary for analysis,
- `01-download-data.R` downloads a spreadsheet, which is stored as `lotr_raw.tsv`,

`01-download-data.R`:

```
R> ## download raw data
R> download.file(url = "http://bit.ly/lotr_raw-tsv",
+               destfile = "lotr_raw.tsv")
```

# An example pipeline

In the following, we will work with this toy pipeline:

- `00-packages.R` loads the packages necessary for analysis,
- `01-download-data.R` downloads a spreadsheet, which is stored as `lotr_raw.tsv`,
- `02-process-data.R` imports and processes the data and exports a clean spreadsheet as `lotr_clean.tsv`, and

`02-process-data.R`:

```
R> ## import raw data
R> lotr_dat <- read_tsv("lotr_raw.tsv")
R>
R> ## reorder Film factor levels based on story
R> old_levels <- levels(as.factor(lotr_dat$Film))
R> j_order <- sapply(c("Fellowship", "Towers", "Return"),
+                   function(x) grep(x, old_levels))
R> new_levels <- old_levels[j_order]
R>
R> ## process data set
R> lotr_dat <- lotr_dat %>%
+   # apply new factor levels to Film
+   mutate(Film = factor(as.character(Film), new_levels),
+   # revalue Race
+   Race = recode(Race, `Ainur` = "Wizard", `Men` = "Man")) %>%
+   ## <skipping some steps here to avoid slide overflow>
+
+ ## write data to file
+ write_tsv(lotr_dat, "lotr_clean.tsv")
```

# An example pipeline

In the following, we will work with this toy pipeline:

- `00-packages.R` loads the packages necessary for analysis,
- `01-download-data.R` downloads a spreadsheet, which is stored as `lotr_raw.tsv`,
- `02-process-data.R` imports and processes the data and exports a clean spreadsheet as `lotr_clean.tsv`, and
- `03-plot.R` imports the clean dataset, produces a figure and exports it as `barchart-words-by-race.png`.

`03-plot.R`:

```
R> ## import clean data
R> lotr_dat <- read_tsv("lotr_clean.tsv") %>%
+ # reorder Race based on words spoken
+ mutate(Race = reorder(Race, Words, sum))
R>
R> ## make a plot
R> p <- ggplot(lotr_dat, aes(x = Race, weight = Words)) + geom_bar()
R> ggsave("barchart-words-by-race.png", p)
```

# An example pipeline

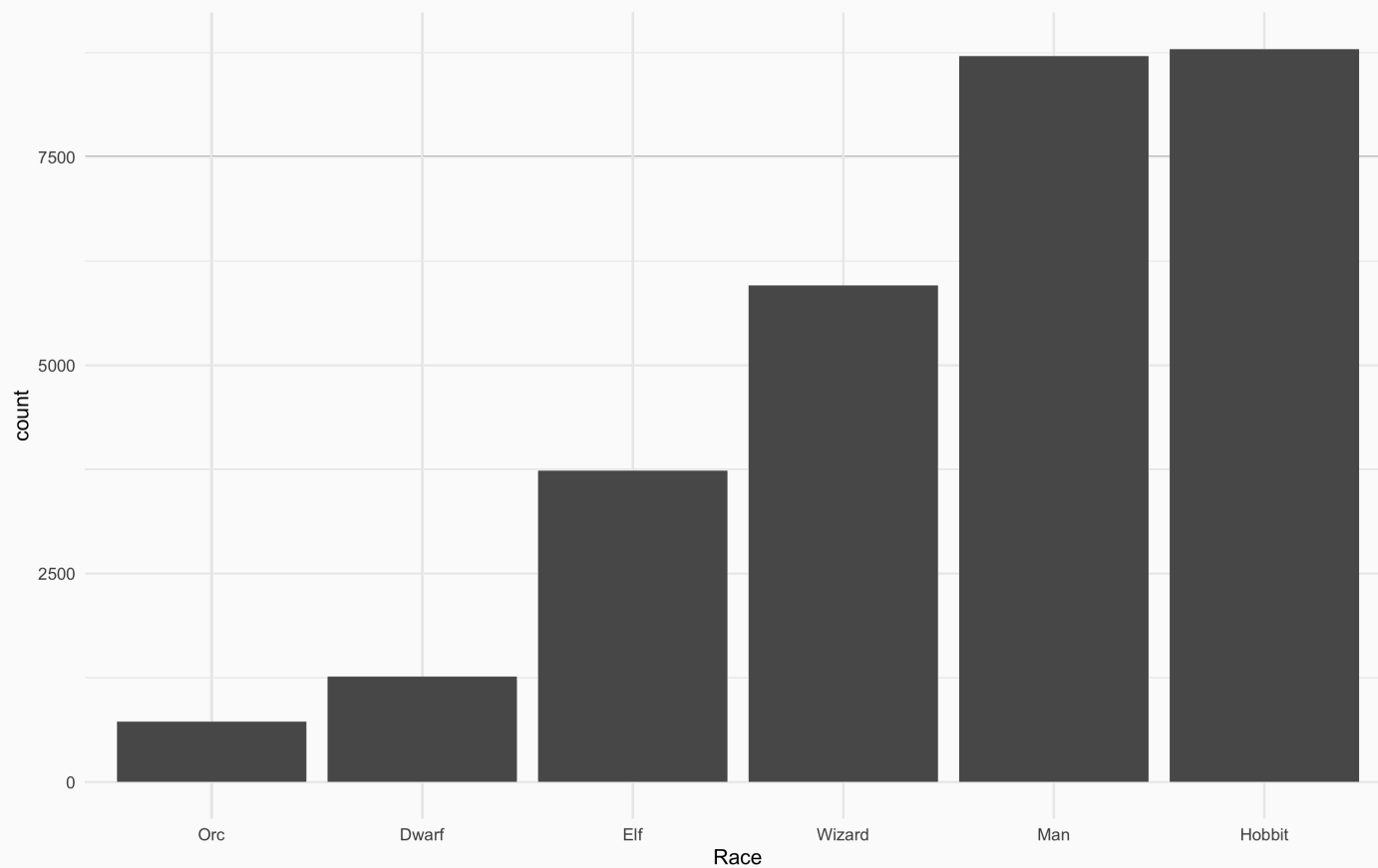
```
R> slice_sample(lotr_dat, n = 10)
```

```
# A tibble: 10 × 5
```

	Film <chr>	Chapter <chr>	Character <chr>	Race <chr>	Words <dbl>
1	The Return Of The King	64: The Mouth Of Sauron	Aragorn	Man	23
2	The Fellowship Of The Ring	36: The Bridge Of Khazad-...	Frodo	Hobb...	4
3	The Two Towers	36: Isengard Unleashed	Saruman	Wiza...	50
4	The Fellowship Of The Ring	42: The Great River	Sam	Hobb...	37
5	The Return Of The King	42: Breaking The Gate Of ...	Gandalf	Wiza...	21
6	The Two Towers	45: The Glittering Caves	Legolas	Elf	36
7	The Two Towers	35: Helm's Deep	Rohan Wa...	Man	22
8	The Fellowship Of The Ring	33: Moria	Aragorn	Man	31
9	The Fellowship Of The Ring	43: Parth Galen	Aragorn	Man	79
10	The Return Of The King	24: Courage Is The Best D...	Gothmog	Orc	4

# An example pipeline

```
R> p <- ggplot(lotr_dat, aes(x = Race, weight = Words)) +  
+   geom_bar() + theme_minimal()
```



# Automation using pipelines in R

## Motivation and usage

- The `source()` function reads and parses R code from a file or connection.
- We can build a pipeline by sourcing scripts sequentially.
- This pipeline is usually stored in a "master" script.
- The removal of previous work is optional and maybe redundant. Often the data is overwritten by default.
- It is recommended that the individual scripts are (partial) standalones, i.e. that they import all data they need by default (loading the packages could be considered an exception).
- Note that as long as the environment is not reset, it remains intact across scripts, which is a potential source of error and confusion.

## Example

The master script `master.R`:

```
R> ## clean out any previous work
R> outputs <- c("lotr_raw.tsv",
+              "lotr_clean.tsv",
+              list.files(pattern = "*.png$"))
R> file.remove(outputs)
R>
R> ## run scripts
R> source("00-packages.R")
R> source("01-download-data.R")
R> source("02-process-data.R")
R> source("03-plot.R")
```

# Automation using the Shell and Rscript

## Motivation and usage

- Alternatively to using an R master script, we can also run the pipeline from the command line.
- Note that here, the environments don't carry over across `Rscript` calls. The scripts definitely have to run in a standalone fashion (i.e., load packages, import all necessary data, etc.).
- The working directory should be set either in the script(s) or in the shell with `cd`.

## Example

The master script `master.sh`:

```
#!/bin/sh
cd /Users/simonmunzert/github/examples/02-automation
set -eux
Rscript 01-download-data.R
Rscript 02-process-data.R
Rscript 03-plot.R
```

The `set` command allows to adjust some base shell parameters:

- `-e`: Stop at first error
- `-u`: Undefined variables are an error
- `-x`: Print each command as it is run

For more information on `set`, see [here](#).



# Automation using the Shell and Rscript

## Motivation and usage

- Alternatively to using an R master script, we can also run the pipeline from the command line.
- Note that here, the environments don't carry over across `Rscript` calls. The scripts definitely have to run in a standalone fashion (i.e., load packages, import all necessary data, etc.).
- The working directory should be set either in the script(s) or in the shell with `cd`.
- One advantage of this approach is that it can be easily coupled with other command line tools, building a **polyglot pipeline**.

## Example

The master script `master.sh`:

```
#!/bin/sh
cd /Users/simonmunzert/github/examples/02-automation
set -eux
curl -L http://bit.ly/lotr_raw-tsv > lotr_raw.tsv
Rscript 02-process-data.R
Rscript 03-plot.R
```

The `set` command allows to adjust some base shell parameters:

- `-e`: Stop at first error
- `-u`: Undefined variables are an error
- `-x`: Print each command as it is run

For more information on `set`, see [here](#).

# Automation using Make

## Motivation and usage

- **Make** is an automation tool that allows us to specify and manage build processes.
- It is commonly run via the shell.
- At the heart of a make operation is the `makefile` (or `Makefile`, `GNUmakefile`), a script which serves as a recipe for the building process.
- A `makefile` is written following a particular syntax and in a declarative fashion.
- Conceptually, the recipe describes which files are built how and using what input.

## Advantages of Make

- It looks at which files you have and automatically figures out how to create the files that you have. For complex pipelines this "automation of the automation process" can be very helpful.
- While shell scripts give *one* order in which you can successfully run the pipeline, Make will figure out the parts of the pipeline (and their order) that are needed to build a desired target.



# Automation using Make (cont.)

## Basic syntax

Each batch of lines indicates

- a file to be created (the target),
- the files it depends on (the prerequisites), and
- set of commands needed to construct the target from the dependent files.

Dependencies propagate.

- To create any of the `png` figures, we need `lotr_clean.tsv`.
- If this file changes, the `png`s change as well when they're built.

## Example `makefile`

```
all: lotr_clean.tsv barchart-words-by-race.png words-histogram.png

lotr_raw.tsv:
    curl -L http://bit.ly/lotr_raw-tsv > lotr_raw.tsv

lotr_clean.tsv: lotr_raw.tsv 02-process-data.R
    Rscript 02-process-data.R

barchart-words-by-race.png: lotr_clean.tsv 03-plot.R
    Rscript 03-plot.R

words-histogram.png: lotr_clean.tsv
    Rscript -e 'library(ggplot2);
    qplot(Words, data = read.delim("$<"), geom = "histogram");
    ggsave("$@")'
    rm Rplots.pdf

clean:
    rm -f lotr_raw.tsv lotr_clean.tsv *.png
```

# Automation using Make (cont.)

## Getting Make to run

- Using the command line, go into the directory for your project.
- Create the `Makefile` file.<sup>1</sup>
- The most basic Make commands are `make all` and `make clean` which builds (or deletes) all output as specified in the script.

## Example `makefile`

```
all: lotr_clean.tsv barchart-words-by-race.png words-histogram.png

lotr_raw.tsv:
    curl -L http://bit.ly/lotr_raw-tsv > lotr_raw.tsv

lotr_clean.tsv: lotr_raw.tsv 02-process-data.R
    Rscript 02-process-data.R

barchart-words-by-race.png: lotr_clean.tsv 03-plot.R
    Rscript 03-plot.R

words-histogram.png: lotr_clean.tsv
    Rscript -e 'library(ggplot2);
    qplot(Words, data = read.delim("$<"), geom = "histogram");
    ggsave("$@")'
    rm Rplots.pdf

clean:
    rm -f lotr_raw.tsv lotr_clean.tsv *.png
```

<sup>1</sup>While the basic syntax is simple (see right), the devil's in the detail. Check out resources listed on the next slide if you want to learn more.

# Automation using Make - FAQ

## Does it work on Windows?

To install and run `make` on Windows, check out [these instructions](#).

## Where can I learn more?

If you consider working with Make, check out the [official manual](#), [this helpful tutorial](#), Karl Broman's [excellent minimal make introduction](#), or [this Stat545 piece](#).

## This is dusty technology. Are there alternatives?

In the context of data science with R, the `targets` package is an interesting option. It provides R functionality to define a Make-style pipeline. Check out the [overview](#) and [manual](#).



# Scheduling

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# Scheduling

HOW LONG CAN YOU WORK ON MAKING A ROUTINE TASK MORE EFFICIENT BEFORE YOU'RE SPENDING MORE TIME THAN YOU SAVE?  
(ACROSS FIVE YEARS)

		HOW OFTEN YOU DO THE TASK					
		50/DAY	5/DAY	DAILY	WEEKLY	MONTHLY	YEARLY
HOW MUCH TIME YOU SHAVE OFF	1 SECOND	<div><div>1</div></div> DAY	2 HOURS	30 MINUTES	4 MINUTES	1 MINUTE	5 SECONDS
	5 SECONDS	<div><div>5</div></div> DAYS	12 HOURS	2 HOURS	21 MINUTES	5 MINUTES	25 SECONDS
	30 SECONDS	<div><div></div><div></div><div></div><div></div></div> 4 WEEKS	<div><div>3</div></div> DAYS	12 HOURS	2 HOURS	30 MINUTES	2 MINUTES
	1 MINUTE	<div><div></div><div></div><div></div><div></div><div></div></div> 8 WEEKS	<div><div>6</div></div> DAYS	<div><div>1</div></div> DAY	4 HOURS	1 HOUR	5 MINUTES
	5 MINUTES	9 MONTHS	<div><div></div><div></div><div></div><div></div></div> 4 WEEKS	<div><div>6</div></div> DAYS	21 HOURS	5 HOURS	25 MINUTES
	30 MINUTES		6 MONTHS	<div><div></div><div></div><div></div><div></div><div></div></div> 5 WEEKS	<div><div>5</div></div> DAYS	<div><div>1</div></div> DAY	2 HOURS
	1 HOUR		10 MONTHS	2 MONTHS	<div><div>10</div></div> DAYS	<div><div>2</div></div> DAYS	5 HOURS
	6 HOURS				2 MONTHS	<div><div></div><div></div><div></div><div></div></div> 2 WEEKS	<div><div>1</div></div> DAY
	<div><div>1</div></div> DAY					<div><div></div><div></div><div></div><div></div><div></div></div> 8 WEEKS	<div><div>5</div></div> DAYS

Credit [Randall Munroe/xkcd 1205](#)

# Scheduling scripts and processes

## Motivation

- So far, we have automated data science pipelines.
- But the execution of these pipelines still needs to be triggered.
- In some cases, it is desirable to also **automate the initialization** of R scripts (or any processes for that matter) **on a regular basis**, e.g. weekly, daily, on logon, etc.
- This makes particular sense when you have moving parts in your pipeline (most likely: data).

## Common scenarios for scheduling

1. You fetch data from the web on a regular basis (e.g., via scraping scripts or APIs).
2. You generate daily/weekly/monthly reports/tweets based on changing data.
3. You build an alert control system informing you about anomalies in a database.



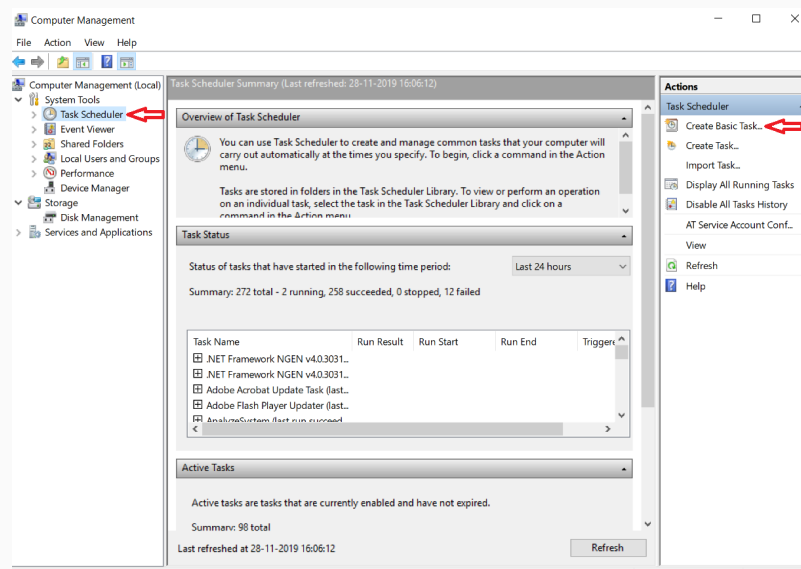
Credit [Simone Giertz](#)



# Scheduling scripts and processes on Windows

## Scheduling options

- Processes on Windows can be scheduled with the **Windows Task Scheduler**.
- Manage them via a GUI (→ Control Panel) or the command line using `schtasks.exe`.
- The R package `taskscheduleR` provides a programmable R interface to the WTS.



## `taskscheduleR` example

```
R> library(taskscheduleR)
```

# Scheduling scripts and processes on a Mac

## Scheduling options

- On macOS you can schedule background jobs using `cron` and `launchd`.
- `launchd`<sup>1</sup> was created by Apple as a replacement for the popular Linux utility `cron` (`deprecated` but still usable).
- The R package `cronR` provides a programmable R interface.
- `cron` syntax for more complex scheduling:

The diagram illustrates the cron syntax with five numbered fields and their corresponding units, followed by a path to a file. Below this, it provides a 'Timing Syntax Example' with three sample cron entries and their descriptions.

1	2	3	4	5	
Minute	Hour	Day of Month	Month	Day of Week	/PATH/TO/FILE

**Timing Syntax Example**

- 0 8 \*\*\* This will run once a day at 8AM
- 0 \*\*\* 0 This will run on Sunday every hour
- 0 10-15 \*\*\* This will run once every hour between 10:00 to 15:00

## `cronR` example

```
R> library(cronR)
R> myscript ← "examples/scrape-wiki.R"
R> # Create bash code for crontab to execute R script
1R> cmd ← cron_rscript(myscript)
R> For more resources on scheduling with launchd, check out this and this and this.
```

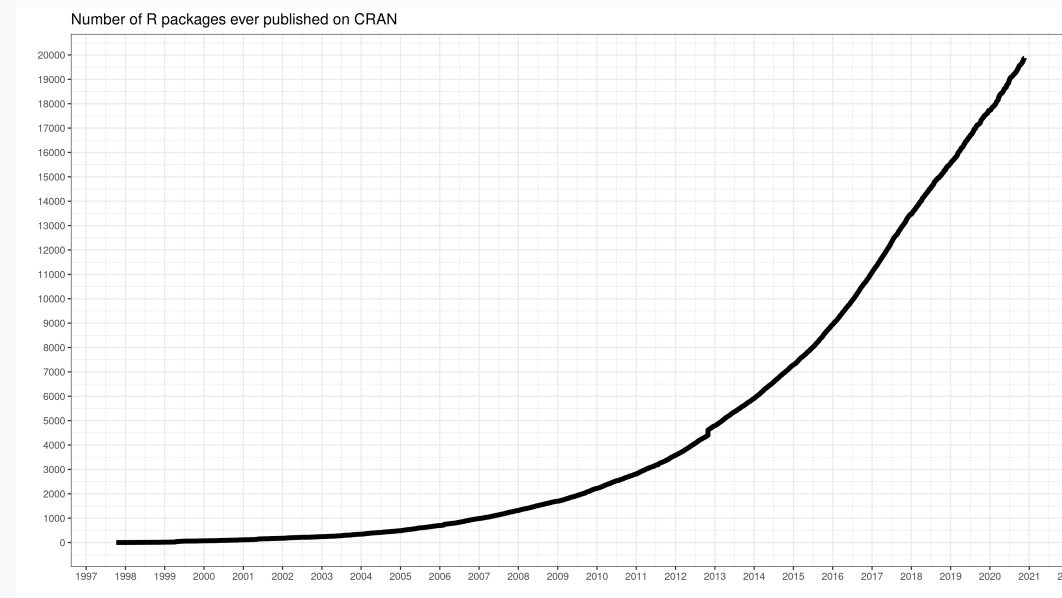
# R packages

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# Writing an R package

## The state of the R package ecosystem

- As of November 2021, the CRAN package repository features more than 18,000 packages.
- Many, many more are available on GitHub and other code sharing platforms.
- R has a vivid community that continuous to create and build extensions and maintain the existing environment. Many of them have much more training and time to invest in software development.
- So, why should we (and with that I mean YOU) write yet another R package?



Credit **daroczig**

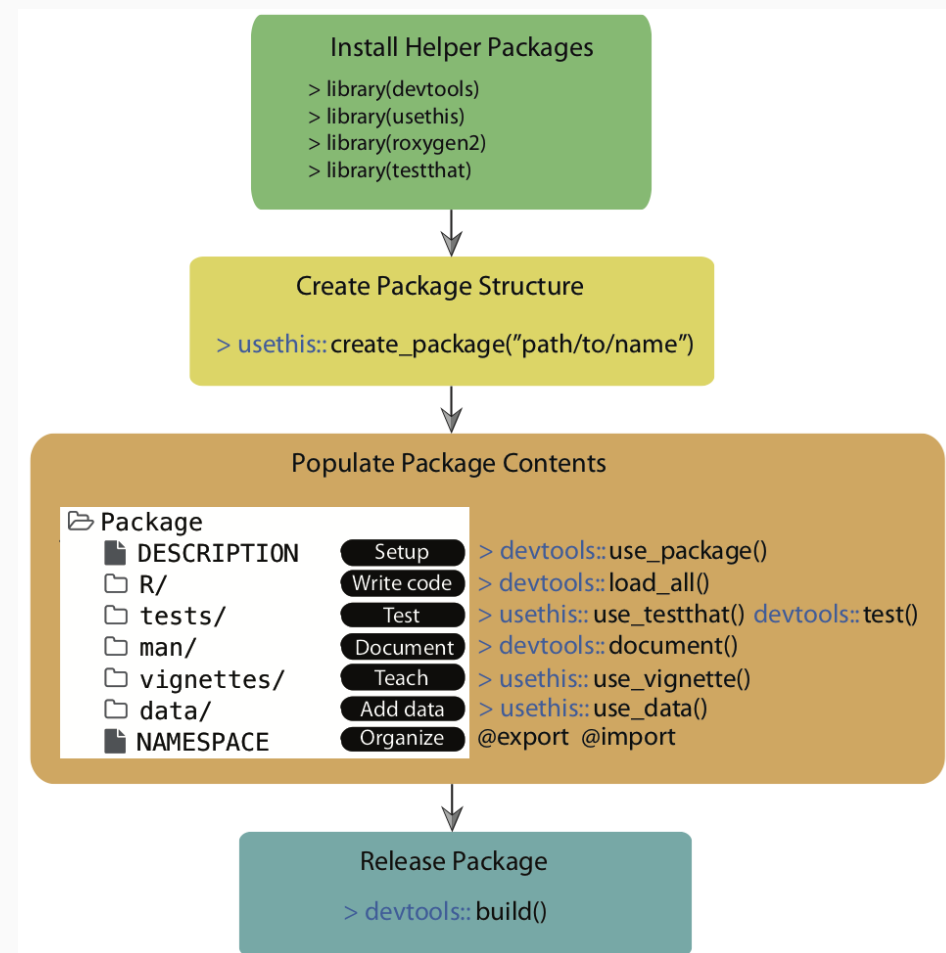
# Why create another R package?

1. **Thinking in functions.** R is a functional programming language, and packages bundle functions. Thinking of projects as packages is consistent with a functional mindset.
2. **Automation and transportability.** By turning tasks into functions you save repetitive typing, keep frequently-used code together, and let code travel across projects.
3. **Collaboration and transparency.** Packages are ideal to make functionality available to others, but also to let others contribute. As a side effect, it nudges you to document your functions properly and gives you the opportunity to let others review and improve your code easily.
4. **Visibility and productization.** Publishing code in packages is potentially giving you project a big boost in visibility. Also, it is more likely to be perceived as a product than an insular project.



# Creating a package from start to finish

1. Choose a package name
2. Set up your package with RStudio (and GitHub)
3. Fill your package with life
  - Add functions
  - Write help files
  - Write a DESCRIPTION
  - Add internal data
4. Check your package
  - Write tests
  - Check on various operating systems
  - Check for good coding practice
5. Submit to CRAN (or GitHub early in the process)
6. Promotion
  - Write a vignette
  - Build a package website



Credit Simo Goshev, Steve Worthington

# Tools to get you started

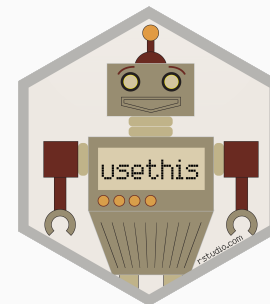
## devtools

- The workhorse of package development in R
- Provides functions that simplify common tasks, such as package setup, simulating installs, compiling from source



## usethis

- Provides workflow utilities for project development (loaded by `devtools`)
- Many `use_*()` functions to help create package tests, data, description, etc.



## testthat

- Provides functions that make it easy to describe what you expect a function to do, including catching errors, warnings, and messages.



## roxygen2

- Provides functions to streamline/automate the documentation of your packages and functions



# An example walkthrough

In the following we will briefly study the process of creating a package.

The [example](#) is taken from [Methods Bites](#), the Blog of the MZES Social Science Data Lab, and developed by [Cosima Meyer](#) and [Dennis Hammerschmidt](#).

The idea is to create a package `overviewR` that helps you to get an overview – hence, the name – of your data with particular emphasis on the extent that your distinct units of observation are covered for the entire time frame of your data set.

The package is [real](#) and lives on both [CRAN](#) and [GitHub](#). Check out the [vignette](#).





# Step 1: Idea and name

## Idea

- I'll leave you alone with that one.
- ... but you might want to check out the **over 18k existing ones that live on CRAN**.

## Name

- Package names can only be letters and numbers and must start with a letter.
- The package `available` helps you — both with getting inspiration for a name and with checking whether your name is available.

## Example

```
R> library(available)
R> # Check for potential names
R> available::suggest("Easily extract information about sample")
```

```
easilyr
```

```
R> # Check whether it's available
R> available::available("overviewR", browse = FALSE)
```

# Step 2: Set up your package

## Option 1: via RStudio and GitHub

- Use RStudio's Project Wizard and click on `File` > `New Project ...` > `New Directory` > `R Package`.
- Check the box `Create a git` to set up a local git.

## Option 2: `usethis`

- Use `usethis::create_package()`, which will set up a template package directory in the specified folder.
- You have to take care of version control yourself (recommendation: initiate project on GitHub first).

## Example

```
R> create_package("overviewR", open = FALSE)
```

```
✓ Creating 'overviewR/'
✓ Setting active project to '/Users/simonmunzert/github/intro-to-data-science-21/lectures/10-debugging-automatio
✓ Creating 'R/'
✓ Writing 'DESCRIPTION'
Package: overviewR
Title: What the Package Does (One Line, Title Case)
Version: 0.0.0.9999
```

# Step 2: Set up your package (cont.)

## Basic components

1. The `DESCRIPTION` file
  - stores metadata about the package
  - lists dependencies if any
  - is pre-generated by `roxygen2`

## Example

**Package:** overviewR

**Title:** What the Package Does (One Line, Title Case)

**Version:** 0.0.0.9000

**Authors@R:**

```
person(given = "First",  
       family = "Last",  
       role = c("aut", "cre"),  
       email = "first.last@example.com",  
       comment = c(ORCID = "YOUR-ORCID-ID"))
```

**Description:** What the package does (one paragraph).

**License:** ``use_mit_license()``, ``use_gpl3_license()`` or friends to pick a  
license

# Step 2: Set up your package (cont.)

## Basic components

1. The `DESCRIPTION` file
  - stores metadata about the package
  - lists dependencies if any
  - is pre-generated by `roxygen2`
  - it will later look like this

## Example

**Type:** Package

**Package:** overviewR

**Title:** Easily Extracting Information About Your Data

**Version:** 0.0.2

**Authors@R:** c(

```
  person("Cosima", "Meyer", email = "XX@XX.com", role = c("cre","aut")),  
  person("Dennis", "Hammerschmidt", email = "XX@XX.com", role = "aut"))
```

**Description:** Makes it easy to display descriptive information on a data set. Getting an easy overview of a data set by displaying and visualizing sample information in different tables (e.g., time and scope conditions). The package also provides publishable TeX code to

# Step 2: Set up your package (cont.)

## Basic components

1. The `DESCRIPTION` file
  - stores metadata about the package
  - lists dependencies if any
  - is pre-generated by `roxygen2`
  - it will later look like this
  - and displayed online like this

## Example

### **overviewR: Easily Extracting Information About Your Data**

Makes it easy to display descriptive information on a data set. Getting an easy overview of a data set by displaying and visualizing sample information in different tables (e.g., time and scope conditions). The package also provides publishable 'LaTeX' code to present the sample information.

Version:	0.0.7
Depends:	R (≥ 3.5.0)
Imports:	<a href="#">dplyr</a> (≥ 1.0.0), <a href="#">ggplot2</a> (≥ 3.3.2), <a href="#">tibble</a> (≥ 3.0.1)
Suggests:	<a href="#">covr</a> , <a href="#">devtools</a> , <a href="#">knitr</a> , <a href="#">pkgdown</a> , <a href="#">rmarkdown</a> , <a href="#">spelling</a> , <a href="#">testthat</a>
Published:	2020-11-23
Author:	Cosima Meyer [cre, aut], Dennis Hammerschmidt [aut]
Maintainer:	Cosima Meyer <cosima.meyer at gmail.com>

# Step 2: Set up your package (cont.)

## Basic components

1. The `DESCRIPTION` file
  - stores metadata about the package
  - lists dependencies if any
  - is pre-generated by `roxygen2`
  - it will later look like this
  - and displayed online like this
2. The `NAMESPACE` file
  - will later contain information on exported and imported functions.
  - helps you manage (and avoid) function clashes
  - will be populated automatically using `devtools::document()`

## Example

```
# Generated by roxygen2: do not edit by hand
```

```
export(overview_crossplot)
```

```
export(overview_crosstab)
```

```
export(overview_heat)
```

# Step 2: Set up your package (cont.)

## Basic components

1. The `DESCRIPTION` file
  - stores metadata about the package
  - lists dependencies if any
  - is pre-generated by `roxygen2`
  - it will later look like this
  - and displayed online like this
2. The `NAMESPACE` file
  - will later contain information on exported and imported functions.
  - helps you manage (and avoid) function clashes
  - will be populated automatically using `devtools::document()`
3. The **R** folder
  - this is where all the functions you will create go

# Step 3: Fill your package with life

## Adding functions

The folder **R** contains all your functions and each function is saved in a new R file where the function name and the file name are the same.

In the preamble of this file, we can add information on the function. This information will be used to render the help files.

## Example

```
#' @title overview_tab
#'  
#'  
#'@description Provides an overview table for the time and scope conditions of  
#'a data set  
#'  
#'@param dat A data set object  
#'@param id Scope (e.g., country codes or individual IDs)  
#'@param time Time (e.g., time periods are given by years, months, ... )  
#'  
#'@return A data frame object that contains a summary of a sample that  
#'can later be converted to a TeX output using \code{overview_print}  
#'@examples
```



# Step 3: Fill your package with life (cont.)

## Adding functions

The folder **R** contains all your functions and each function is saved in a new R file where the function name and the file name are the same.

In the preamble of this file, we can add information on the function. This information will be used to render the help files.

When you execute `devtools::document()`, R automatically generates the respective help file in man as well as the new `NAMESPACE` file.

## Example

```
overview_tab {overviewR}
```

R Documentation

### overview\_tab

#### Description

Provides an overview table for the time and scope conditions of a data set

#### Usage

```
overview_tab(dat, id, time)
```

# Step 6: Install your package!

## Installing a local package

We are now ready to load a developmental version of the package. This works with `devtools::install()`, which will also try to install dependencies of the package from CRAN, if they're not already installed.

You need to run this from the parent working directory that contains the package folder.

We're now ready to call functions from the package.

## Example

```
R> install("overviewR")
```

- ✓ checking **for** file ‘/Users/simonmunzert/github/intro-to-data-science-21/lectures/10-debugging-automation/overviewR.Rproj’
- preparing ‘overviewR’:
- ✓ checking DESCRIPTION meta-information ...
- checking **for** LF line-endings **in source** and make files and shell scripts
- checking **for** empty or unneeded directories
- building ‘overviewR\_0.0.0.9000.tar.gz’

```
Running /Library/Frameworks/R.framework/Resources/bin/R CMD INSTALL \
```

# Steps 3-6

We skipped a couple of important (and some optional) steps now, including:

- Build and check a package, clean up → `devtools::check()`
- Iterative loading and testing → `devtools::load_all()`
- Adding unit tests → `usethis::use_testthat()`
- Import functions from other packages (CRAN package dependency) → `usethis::use_package()`
- Git version control and collaboration → `usethis::use_github()`
- Add a proper public description → `usethis::use_readme_rmd()`
- Build PDF manual → `devtools::build_manual()`
- Add vignettes → `usethis::use_vignette()`
- Add a licence → `usethis::use_gpl_license()`, `usethis::use_mit_license()`, ...
- Convert into a single bundled file (binary or zipped) → `devtools::build()`
- Submit to CRAN → `devtools::release()`
- Build website for your package → `pkgdown::build_site()`

Be sure to check out the [motivating example](#) and more resources (next slide).

# Writing R packages - FAQ

## Is learning this worth the time?

Yes.

## Where can I learn more?

Glad that you're asking! There's tons of materials out there. Apart from the used **tutorial** and the **R packages book**, have a look at the **devtools cheatsheet** and another overview over at **RStudio**. Knowing how to **turn a package into a website** within minutes is fascinating, too.

## When do we need a package, and when is a GitHub repo simply enough?

Do you think of your work as a project or a product? If it's the latter, maybe a package is right for you. (But... a research paper is also a product, right? 🤖)

### Package Development: : CHEAT SHEET

#### Package Structure

A package is a convention for organizing files into directories. This sheet shows how to work with the 7 most common parts of an R package:

Package	DESCRIPTION	SETUP
<input checked="" type="checkbox"/> R/	<input checked="" type="checkbox"/> DESCRIPTION	<input checked="" type="checkbox"/> TESTS
<input checked="" type="checkbox"/> tests/	<input checked="" type="checkbox"/> R/	<input checked="" type="checkbox"/> R/
<input checked="" type="checkbox"/> man/	<input checked="" type="checkbox"/> R/	<input checked="" type="checkbox"/> R/
<input checked="" type="checkbox"/> vignettes/	<input checked="" type="checkbox"/> R/	<input checked="" type="checkbox"/> R/
<input checked="" type="checkbox"/> data/	<input checked="" type="checkbox"/> R/	<input checked="" type="checkbox"/> R/
<input checked="" type="checkbox"/> NAMESPACE	<input checked="" type="checkbox"/> R/	<input checked="" type="checkbox"/> R/

The contents of a package can be stored on disk as:

- **source** - a directory with sub-directories (as above)
- **bundle** - a single compressed file (.tar.gz)
- **library** - a single compressed file optimized for a specific OS

Or installed into an R library (loaded into memory during an R session) or archived online in a repository. Use the functions below to move between these states.

**Install packages()**  
install.packages("source")  
install.packages("bundle")  
install.packages("library")

**R CMD install**  
devtools::install()  
devtools::install\_built()  
devtools::install\_github("github:username/repo")  
devtools::install\_local("local/path/to/package")  
devtools::install\_remote("remote/path/to/package")

**devtools::use\_build\_ignore("file")**  
Adds file to .Rbuildignore, a list of files that will not be included when package is built.

#### Setup (DESCRIPTION)

The **DESCRIPTION** file describes your work, sets up how your package will work with other packages, and applies a copyright.

☒ You must have a **DESCRIPTION** file.

☒ Add the packages that your code relies on with **depends**, **use\_package()**.

☒ Add a package to the imports or suggests field.

**CCO** MIT Some applies to your code if it's shared.

**GPL-2** GPL-2 license applies to your code, and all code anyone builds with it is shared.

**Package:** mypackage  
**Title:** Title of Package  
**Version:** 0.0.0.9000  
**Author:** person("Hedley", "Kahane", email = "hkahane@devtools.com", role = c("aut", "cre"), type = "person")  
**Maintainer:** person("Hedley", "Kahane", email = "hkahane@devtools.com", role = c("aut", "cre"), type = "person")  
**Depends:** R (>= 3.1.0)  
**Imports:** R6, Rcpp  
**Suggests:** testthat, knitr, rmarkdown  
**License:** GPL-2  
**LazyData:** true  
**Roxygen2:** list(when = "source", after = "dev")  
**URL:** [https://github.com/hadley/devtools](#)  
**SystemRequirements:**   
**ConfigFiles:**   
**ExtraFiles:**   
**ExtraSourcelibs:**   
**ExtraTestlibs:**   
**ExtraDataFiles:**   
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**ExtraDataFiles2:**   
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