Coding Basics and Importing Data

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Lesson 2

DLMP Core

Lesson Goals

1. Learn some fundamental of coding

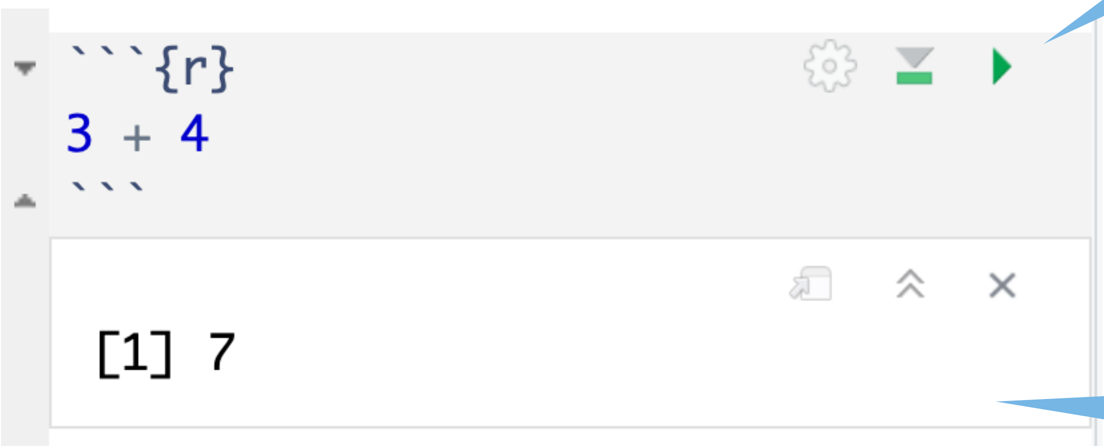
Lesson Objectives

1. Define and use functions
2. Define and create objects in the environment
3. Install and load packages
4. Import data into R
5. Interact with a dataframe

The Basics of Coding

The Basics of Coding: Calculation

- R is a calculator!



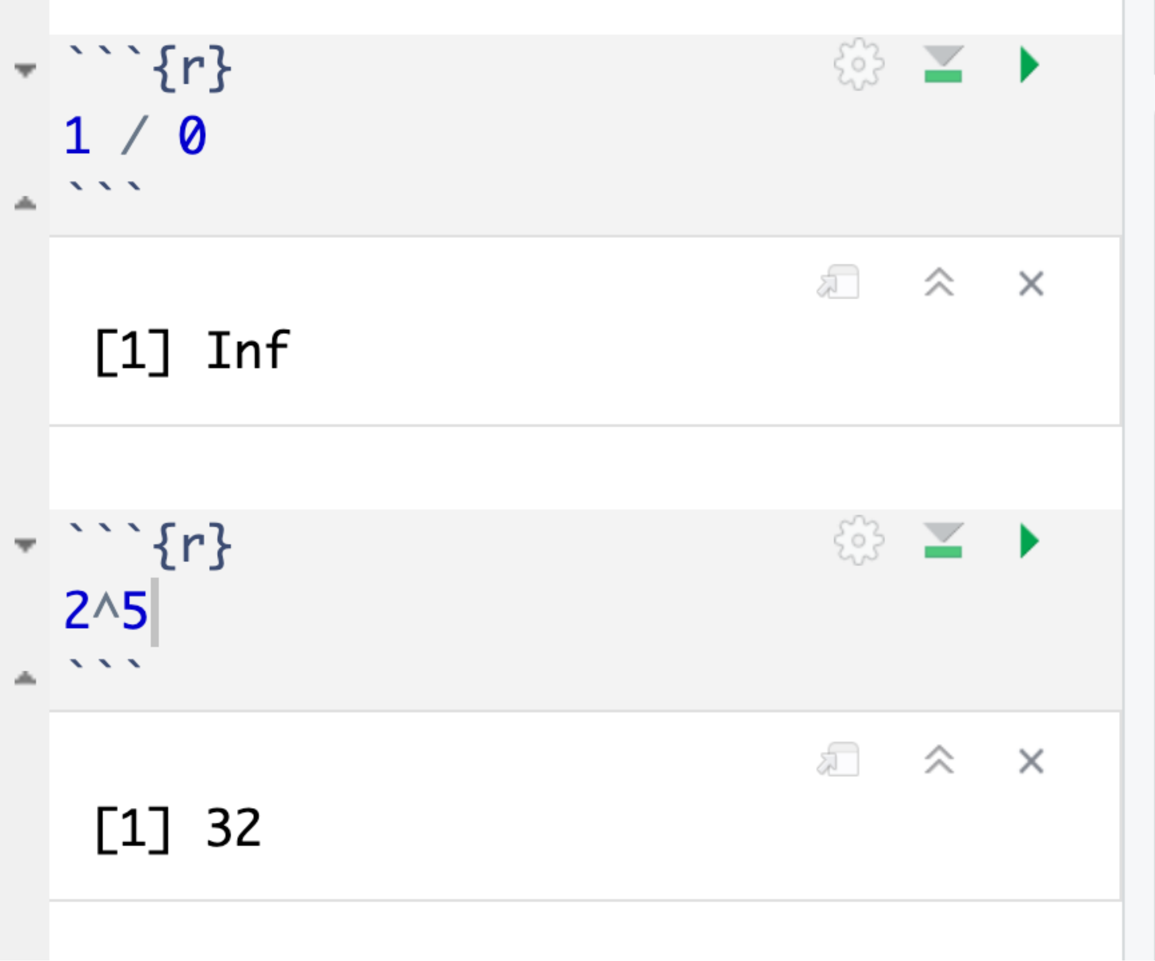
~~~
```{r}
3 + 4
```
~~~

```
[1] 7
```

press play button to execute code

answer returned below

Common arithmetic operations



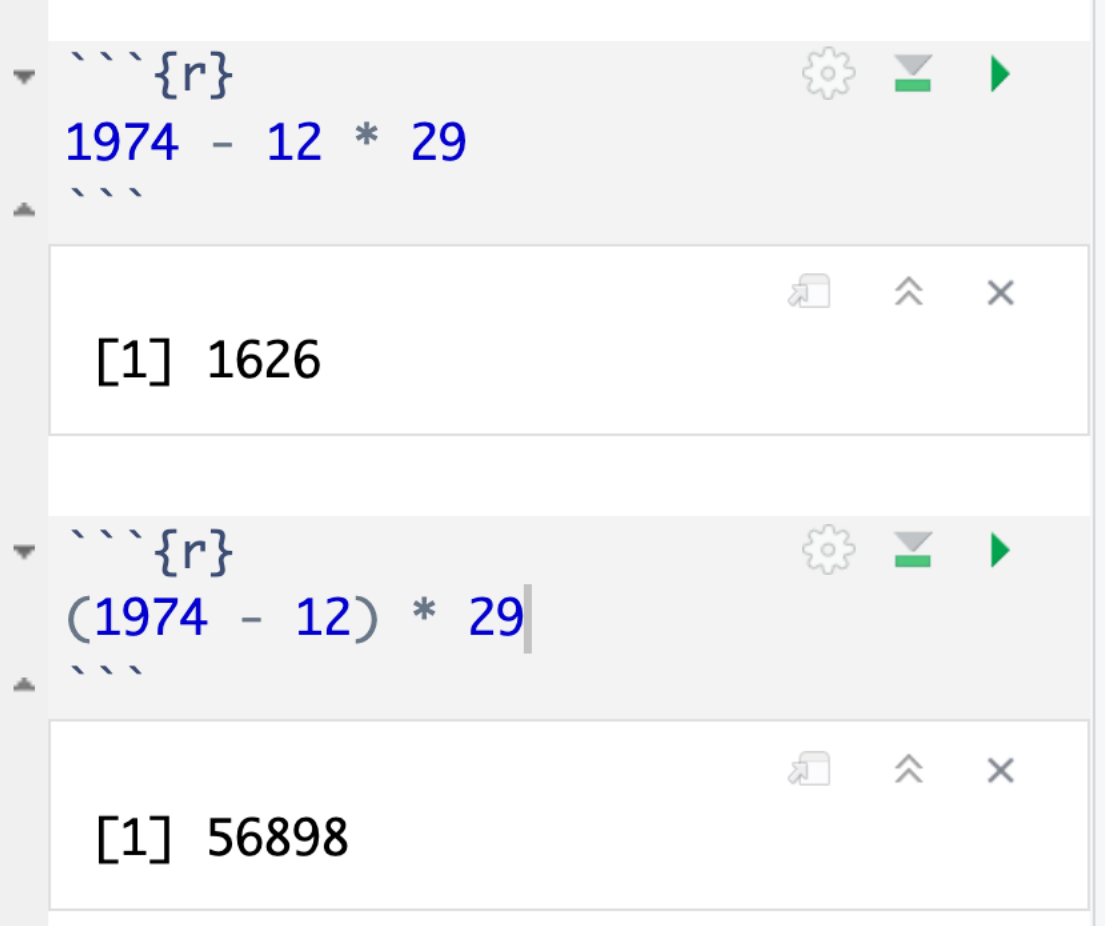
~~~
```{r}
1 / 0
```
~~~

```
[1] Inf
```

~~~
```{r}
2^5
```
~~~

```
[1] 32
```

Don’t forget those math rules



~~~
```{r}
1974 - 12 * 29
```
~~~

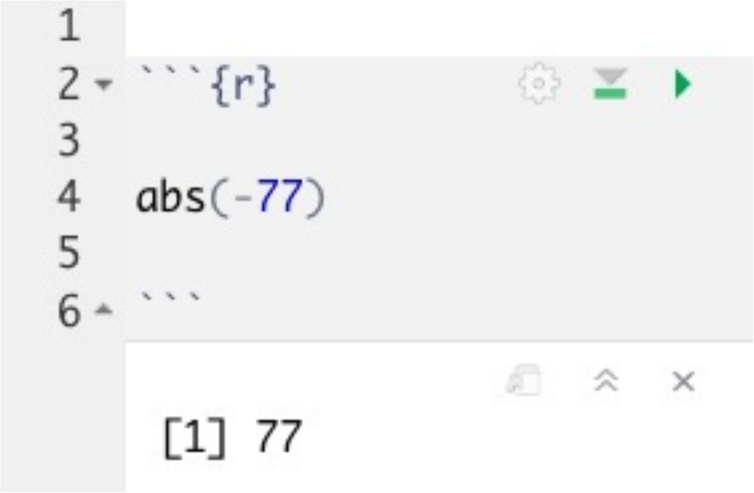
```
[1] 1626
```

~~~
```{r}
(1974 - 12) * 29
```
~~~

```
[1] 56898
```

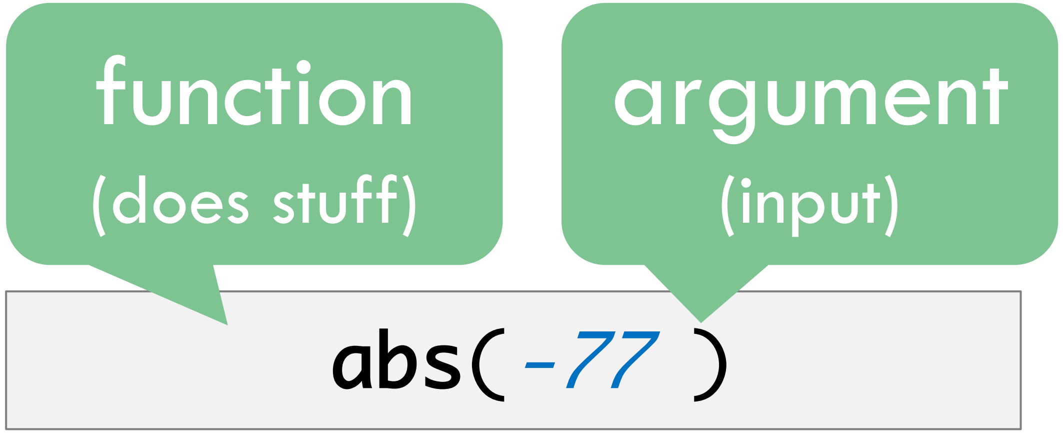
The Basics of Coding: Functions

- Code that extends our reach beyond the basic operators



~~~
```{r}

abs(-77)

```
~~~

```
[1] 77
```



function

(does stuff)

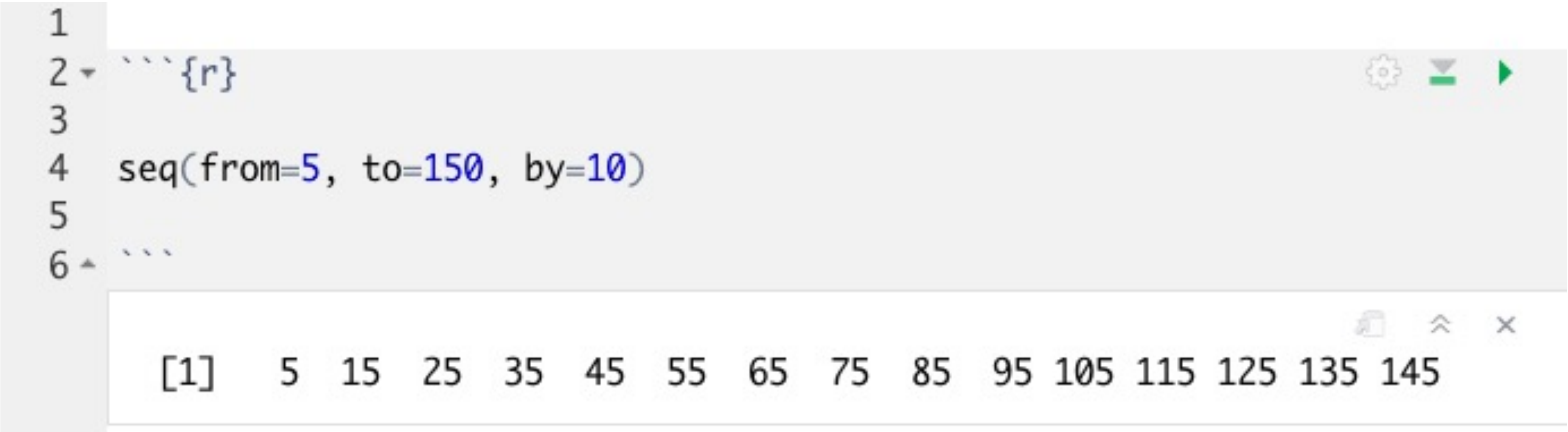
argument

(input)

abs(-77)

Putting Functions to Work

- We can use functions to do more than simple math, we can make things!
- We can create a series of integers (a vector) using the seq() function

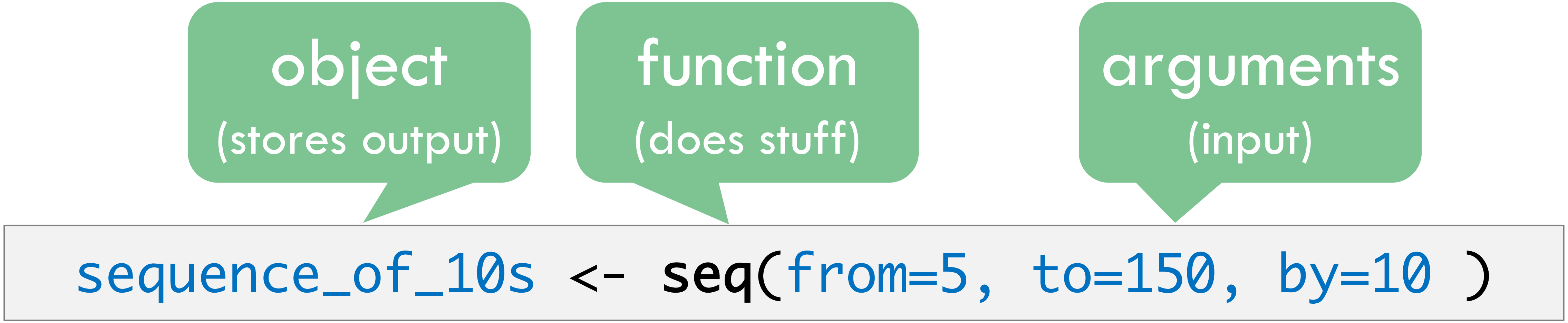


~~~
```{r}

seq(from=5, to=150, by=10)

```
~~~

```
[1]   5  15  25  35  45  55  65  75  85  95 105 115 125 135 145
```

The Basics of Coding: Objects

- Objects are the container for your output



object

(stores output)

function

(does stuff)

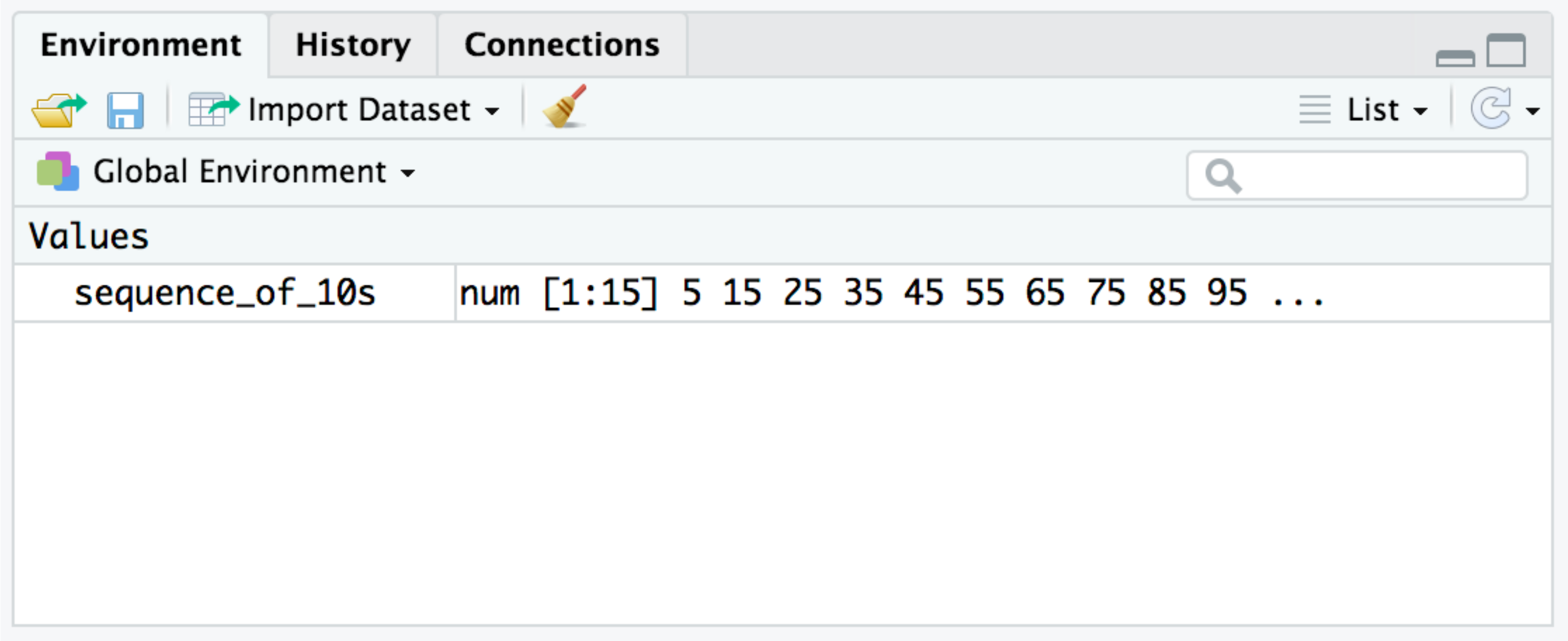
arguments

(input)

```
sequence_of_10s <- seq(from=5, to=150, by=10 )
```

Checking the contents of an object

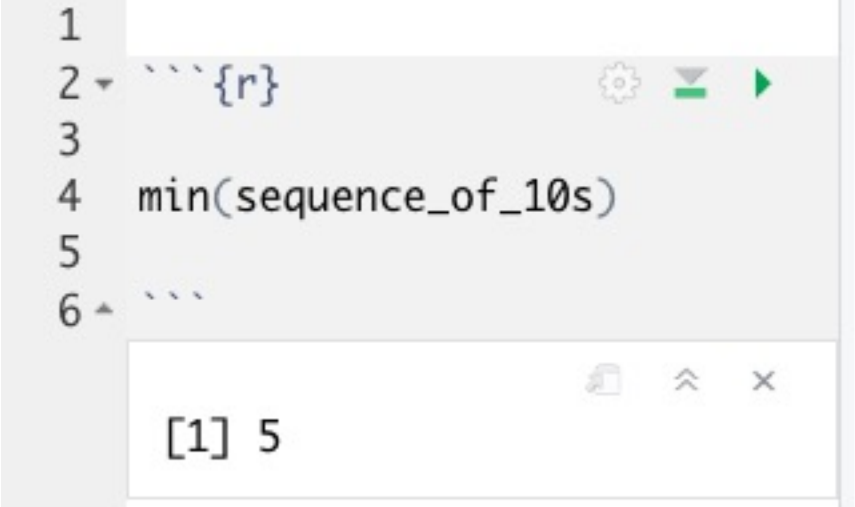
- The environment tab shows us the objects we have created.



```
Values
   sequence_of_10s    num [1:15] 5 15 25 35 45 55 65 75 85 95 ...
```

Bending objects to your will

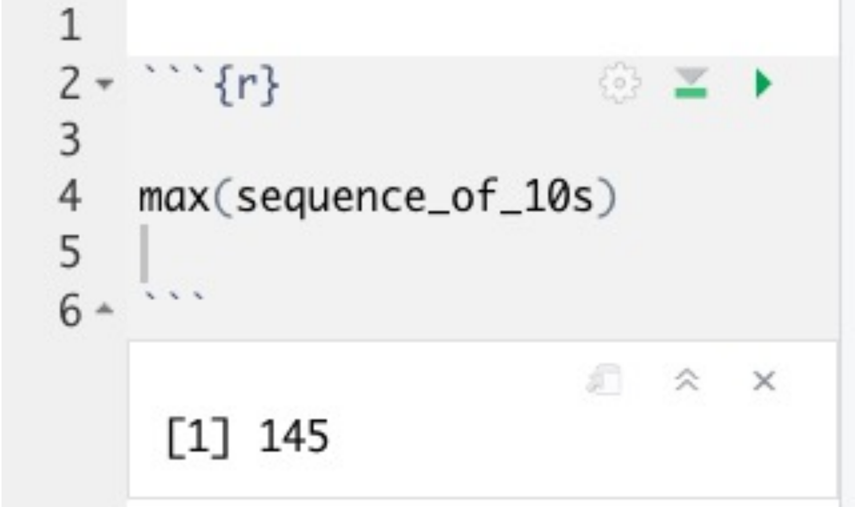
- Once we have created an object we can start to interact with it.
- This includes passing our objects to other functions… Whoa!



~~~~

```{r}

min(sequence_of_10s)

```
~~~~

```
[1] 5
```



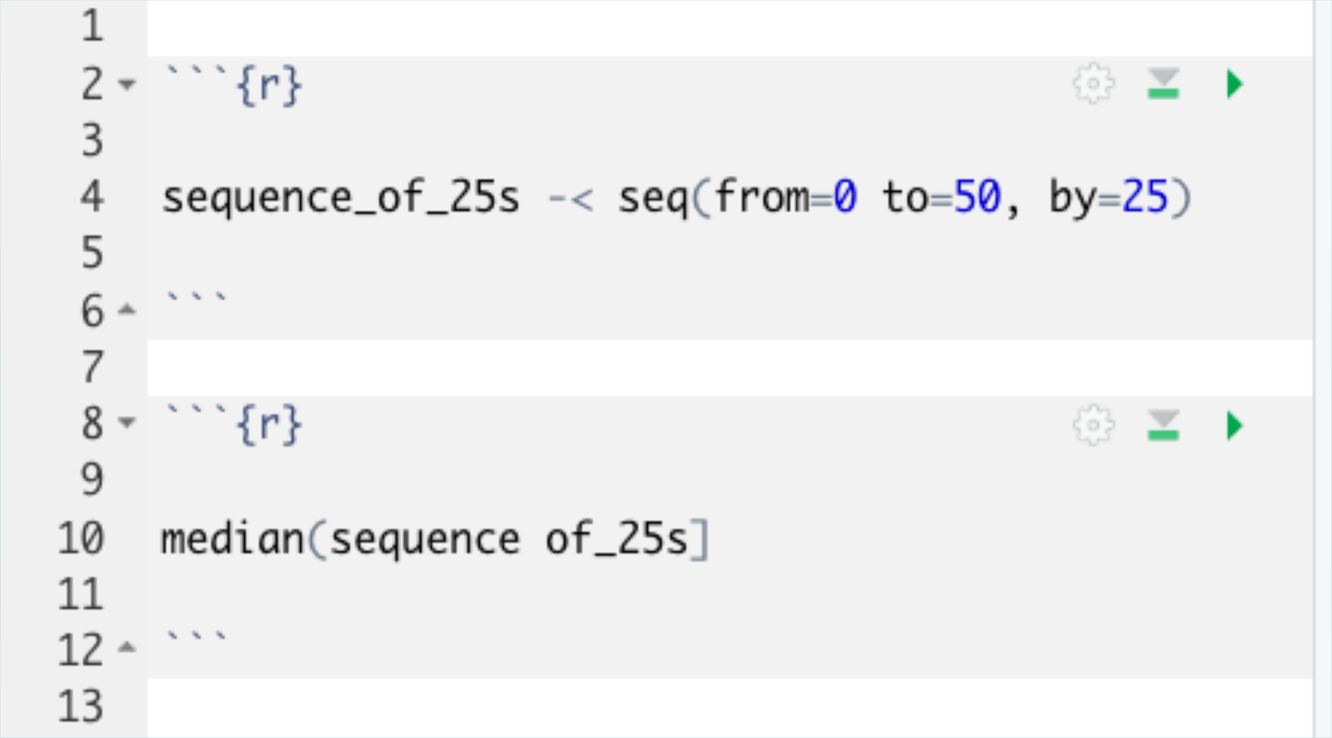
~~~~

```{r}

max(sequence_of_10s)

```
~~~~

```
[1] 145
```

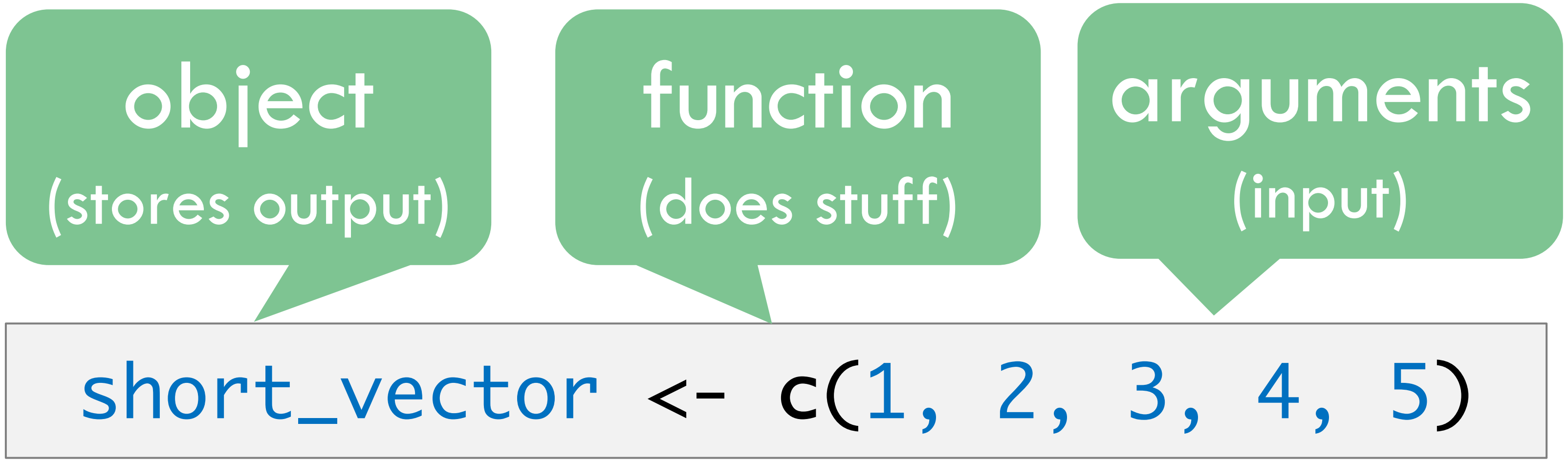
Your Turn #1

I’ve written some code to create a sequence from 0 to 500 in increments of 25 called sequence_of_25s. Ultimately I want to calculate the median value of this sequence. Unfortunately I’ve made some mistakes in my code and I am hoping you can help me find them.



~~~

```{r}

sequence_of_25s -< seq(from=0 to=50, by=25)

```

```{r}

median(sequence of_25s]

```

~~~

Common functions: combine values into a vector



object

(stores output)

function

(does stuff)

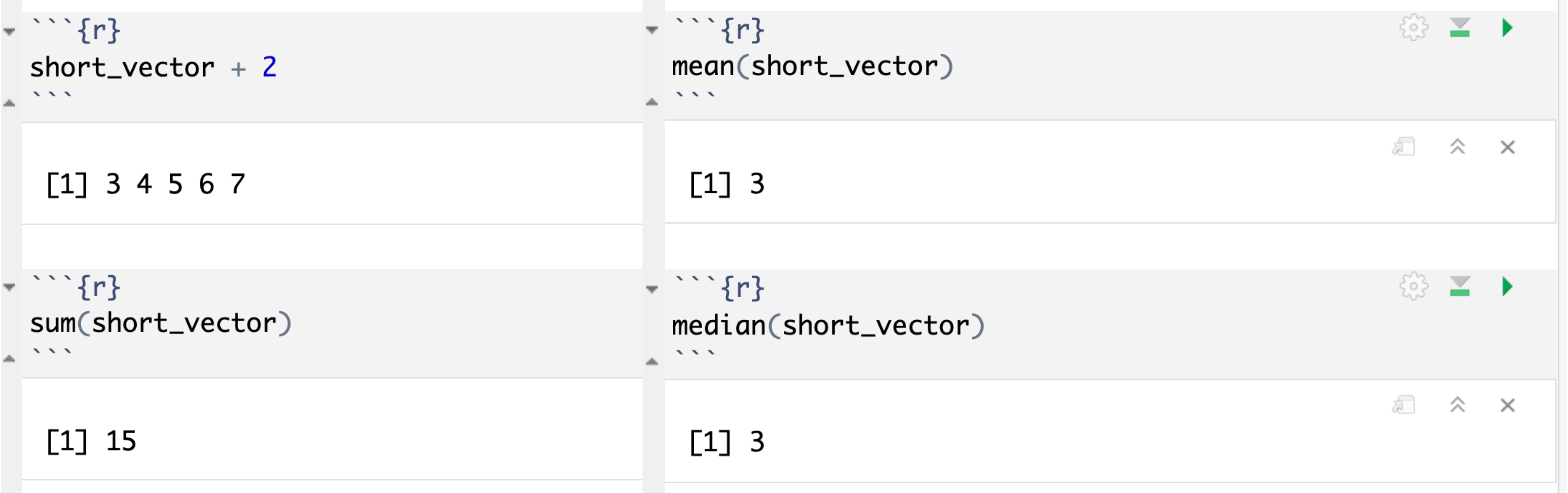
arguments

(input)

```
short_vector <- c(1, 2, 3, 4, 5)
```

- Create an object called short_vector and store a vector containing 1 through 5
- Think of this vector as a column of numbers you can apply functions/perform calculations on

Common functions: simple statistics



~~~
```{r}
short_vector + 2
```
~~~

```
[1] 3 4 5 6 7
```

~~~
```{r}
mean(short_vector)
```
~~~

```
[1] 3
```

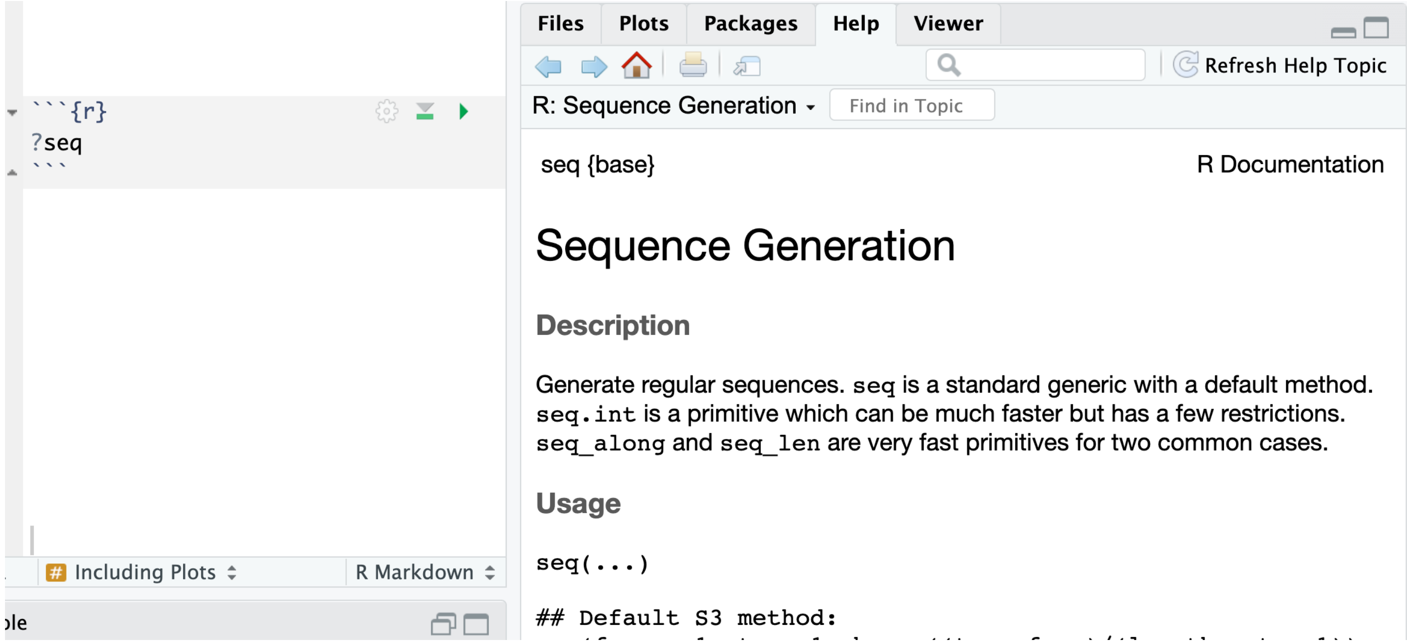
~~~
```{r}
sum(short_vector)
```
~~~

```
[1] 15
```

~~~
```{r}
median(short_vector)
```
~~~

```
[1] 3
```

How do I find out more about functions?



~~~
```{r}
?seq
```
~~~

seq {base} R Documentation

Sequence Generation

Description

Generate regular sequences. `seq` is a standard generic with a default method. `seq.int` is a primitive which can be much faster but has a few restrictions. `seq_along` and `seq_len` are very fast primitives for two common cases.

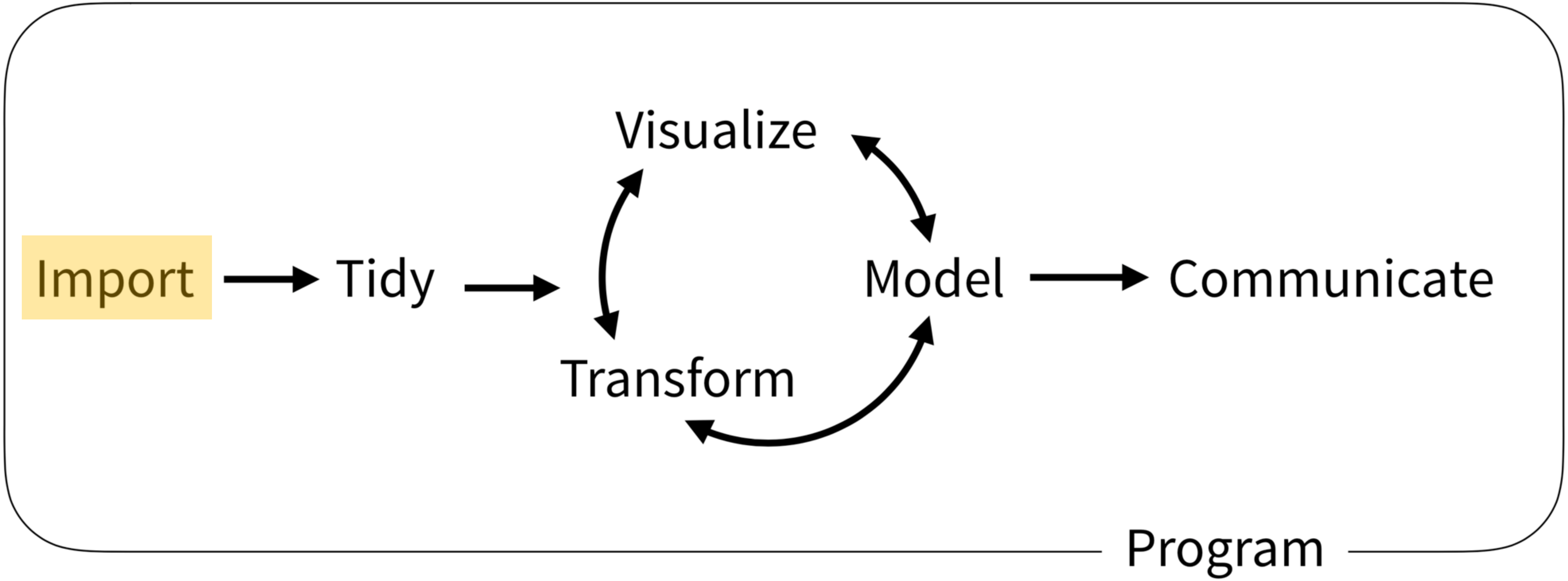
Usage

```
seq(...)

## Default S3 method:
```

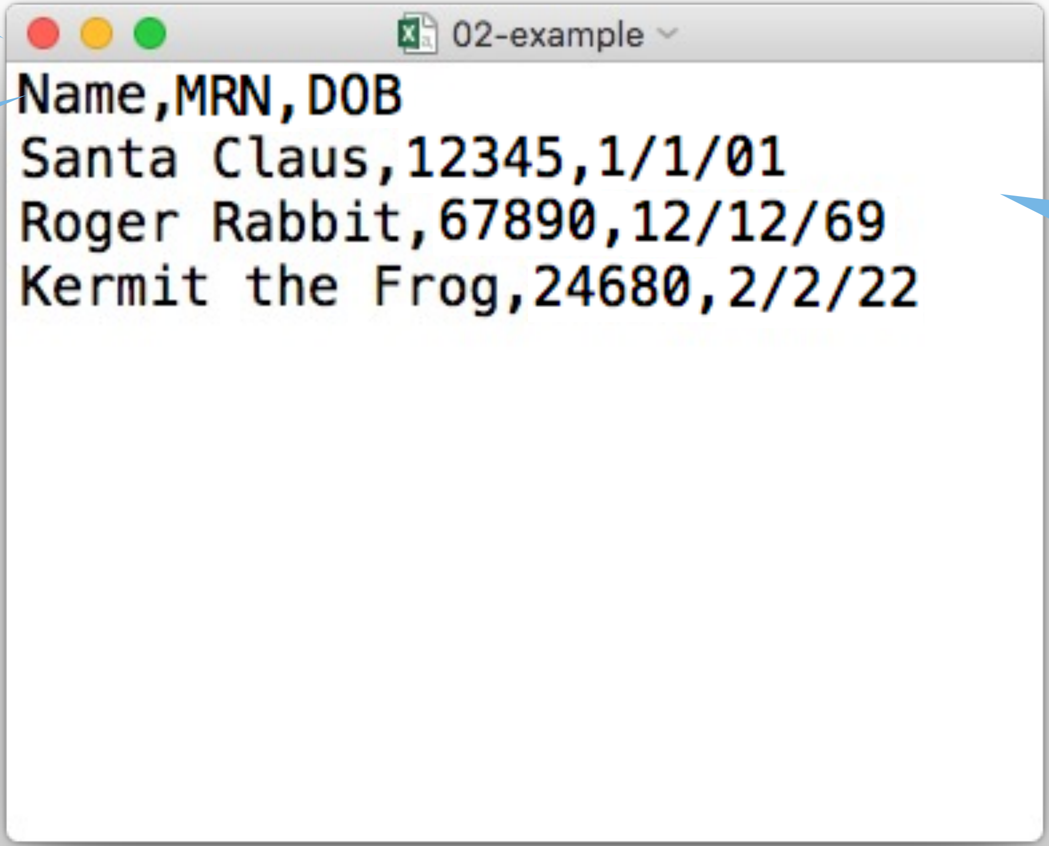
- Work Aids (RStudio Cheat Sheets: https://www.rstudio.com/resources/cheatsheets/)
- A Good Book (R for Data Science: http://r4ds.had.co.nz/)
- The Internet (Stack Overflow: https://stackoverflow.com/)

Importing Data

The Data Analysis Pipeline



From *R for Data Science* (https://r4ds.had.co.nz/introduction.html) csv



```
Name,MRN,DOB
Santa Claus,12345,1/1/01
Roger Rabbit,67890,12/12/69
Kermit the Frog,24680,2/2/22
```

plain text ("flat") file

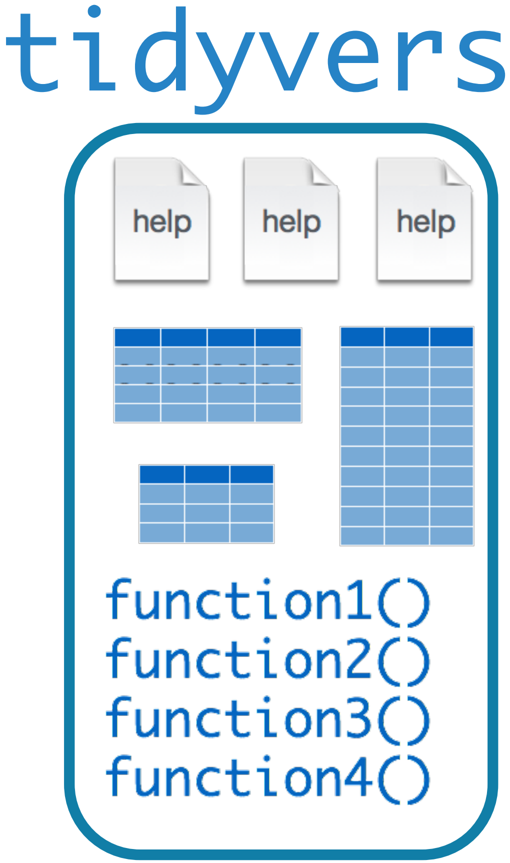
header row

rectangular structure

Tidyverse: R Packages for Data Science

- A consistent way to organize data
- Human readable, concise, consistent code
- Build pipelines from atomic data analysis steps

Installing and loading R packages



tidyverse

function1()
function2()
function3()
function4()

```
install.packages("tidyverse")
```

Downloads files to computer

1 x per computer

```
library("tidyverse")
```

Loads package

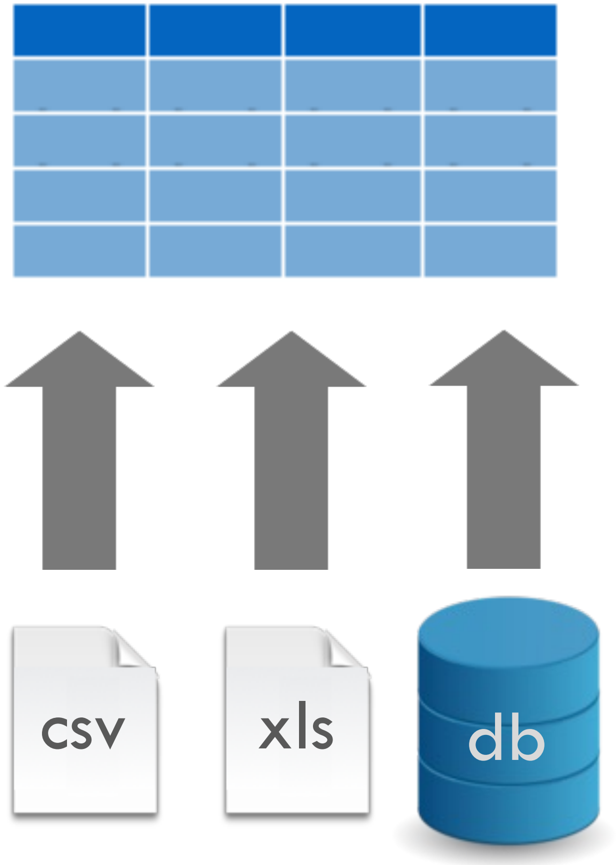
1 x per R Session

Dataframes: Beyond the Vector

- Dataframe is the term for a table

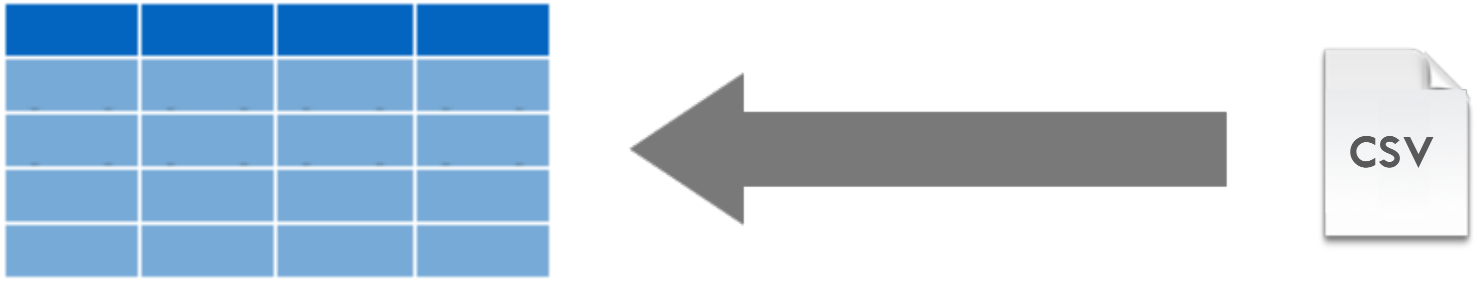
- Dataframes are composed:
  Columns (Variables)
  Rows (Observations)

- Dataframes are objects and can be acted on like other objects



read_csv()

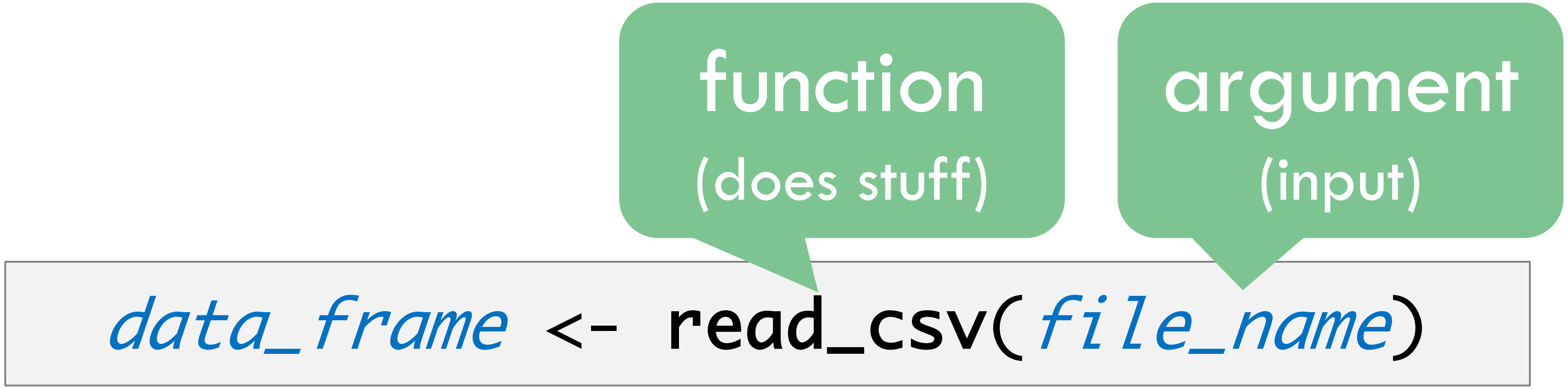
```
data_frame <- read_csv(file_name)
```



function

(does stuff)

```
data_frame <- read_csv(file_name)
```



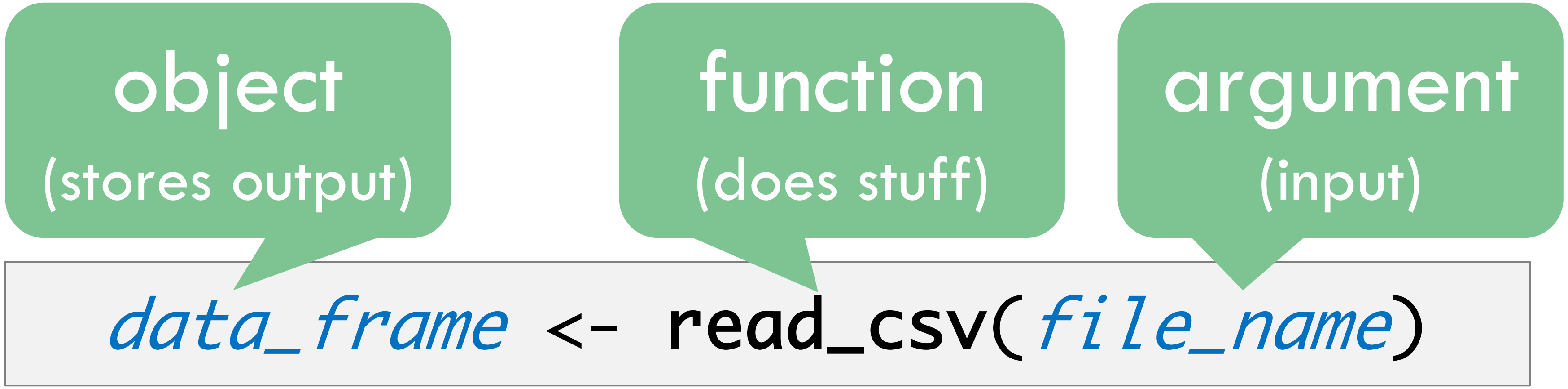
```
data_frame <- read_csv(file_name)
```

function

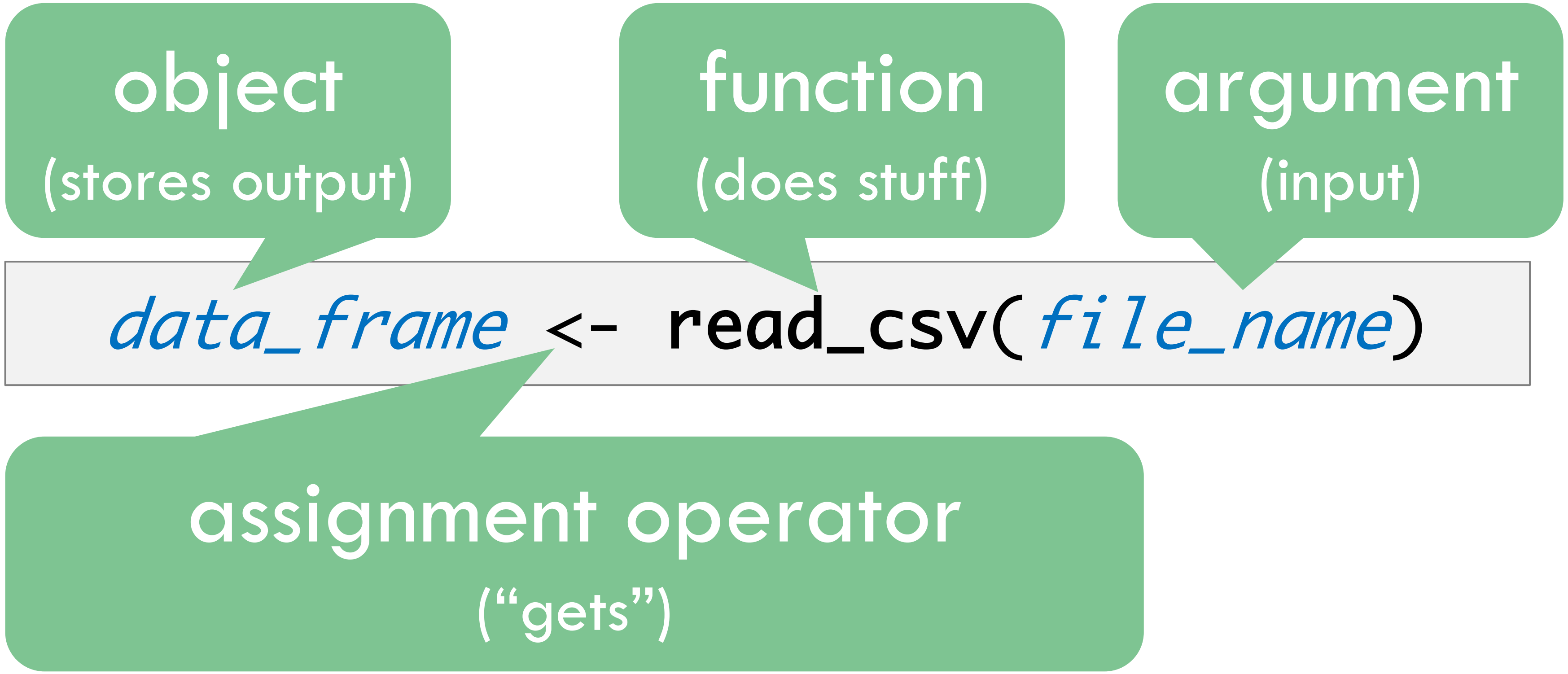
(does stuff)

argument

(input)



```
data_frame <- read_csv(file_name)
```



object

(stores output)

function

(does stuff)

argument

(input)

```
data_frame <- read_csv(file_name)
```

assignment operator

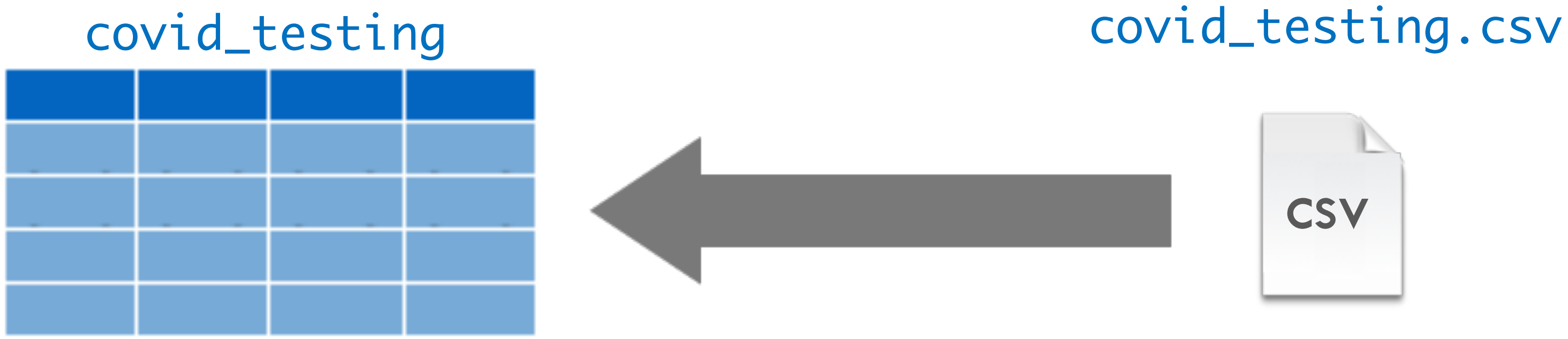
(“gets”)

read_csv()

data frame to read data into

name of CSV file

```
covid_testing <- read_csv("covid_testing.csv")
```



Your Turn #2

In the MISC pane, select the folder:

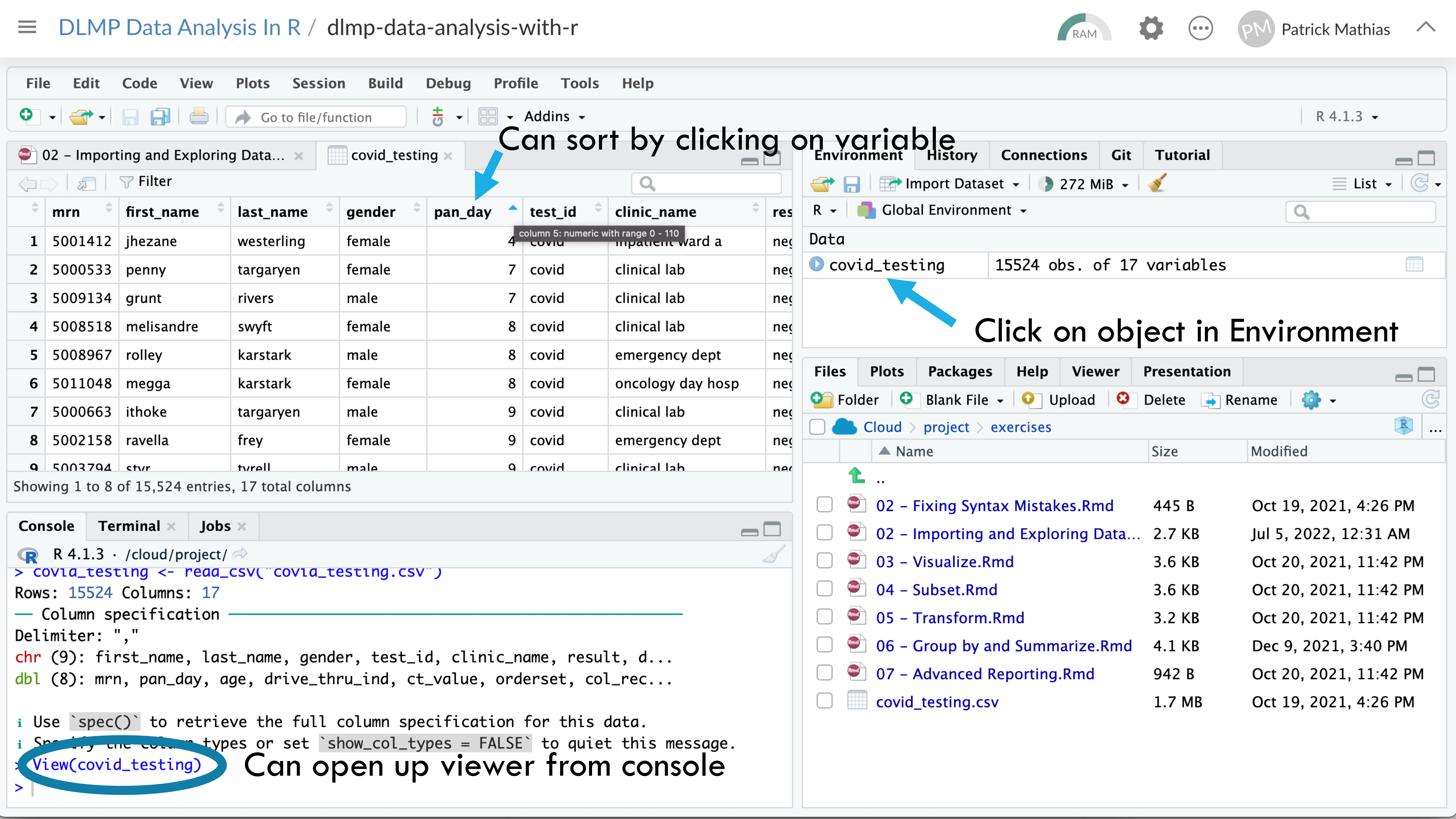
“exercises”

Select the R Markdown file:

“`02 - Importing and Exploring Data.Rmd`”

In the Editor pane, follow the instructions to complete the exercise.

05:00


DLMP Data Analysis In R / dlmp-data-analysis-with-r
RAM
PM Patrick Mathias
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
R 4.1.3
02 – Importing and Exploring Data…
covid_testing
Filter
Environment History Connections Git Tutorial
Import Dataset
272 MiB
List
R
Global Environment
Console Terminal Jobs
Files Plots Packages Help Viewer Presentation
Folder Blank File Upload Delete Rename
Cloud > project > exercises

Can sort by clicking on variable

column 5: numeric with range 0 - 110

	mrn	first_name	last_name	gender	pan_day	test_id	clinic_name	res
1	5001412	jhezane	westerling	female	4	covid	inpatient ward a	neg
2	5000533	penny	targaryen	female	7	covid	clinical lab	neg
3	5009134	grunt	rivers	male	7	covid	clinical lab	neg
4	5008518	melisandre	swyft	female	8	covid	clinical lab	neg
5	5008967	rolley	karstark	male	8	covid	emergency dept	neg
6	5011048	megga	karstark	female	8	covid	oncology day hosp	neg
7	5000663	ithoke	targaryen	male	9	covid	clinical lab	neg
8	5002158	ravella	frey	female	9	covid	emergency dept	neg
9	5003794	styr	tyrell	male	9	covid	clinical lab	neg

Showing 1 to 8 of 15,524 entries, 17 total columns

Data

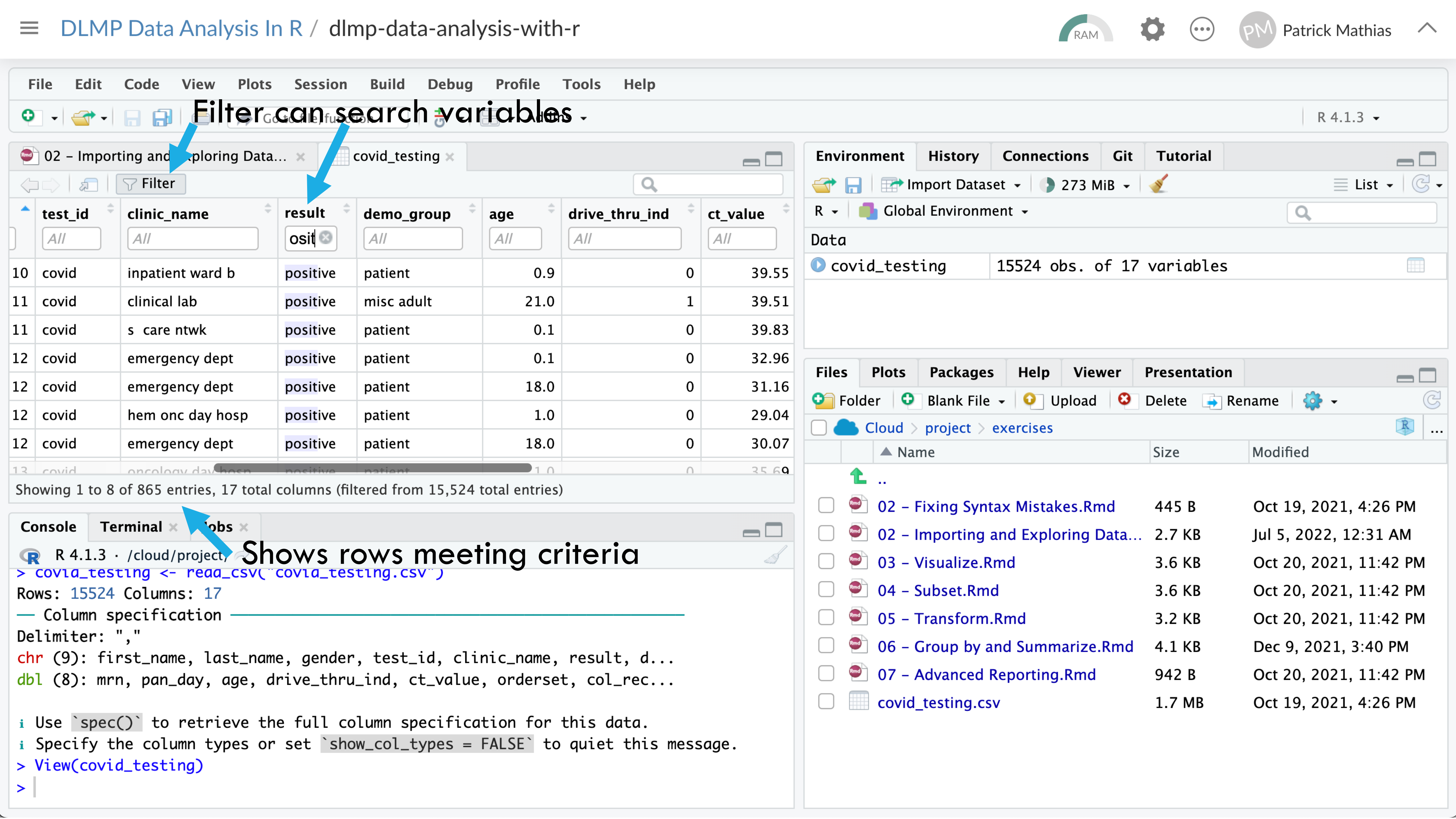
covid_testing	15524 obs. of 17 variables

Click on object in Environment

```
R 4.1.3 · /cloud/project/
> covid_testing <- read_csv("covid_testing.csv")
Rows: 15524 Columns: 17
── Column specification ──────────────────────────────────
Delimiter: ","
chr (9): first_name, last_name, gender, test_id, clinic_name, result, d...
dbl (8): mrn, pan_day, age, drive_thru_ind, ct_value, orderset, col_rec...

ℹ Use `spec()` to retrieve the full column specification for this data.
ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
> View(covid_testing)
>
```

Can open up viewer from console

Name	Size	Modified
..		
02 – Fixing Syntax Mistakes.Rmd	445 B	Oct 19, 2021, 4:26 PM
02 – Importing and Exploring Data…	2.7 KB	Jul 5, 2022, 12:31 AM
03 – Visualize.Rmd	3.6 KB	Oct 20, 2021, 11:42 PM
04 – Subset.Rmd	3.6 KB	Oct 20, 2021, 11:42 PM
05 – Transform.Rmd	3.2 KB	Oct 20, 2021, 11:42 PM
06 – Group by and Summarize.Rmd	4.1 KB	Dec 9, 2021, 3:40 PM
07 – Advanced Reporting.Rmd	942 B	Oct 20, 2021, 11:42 PM
covid_testing.csv	1.7 MB	Oct 19, 2021, 4:26 PM



DLMP Data Analysis In R / dlmp-data-analysis-with-r
RAM
Patrick Mathias
File Edit Code View Plots Session Build Debug Profile Tools Help
R 4.1.3
02 – Importing and Exploring Data...
covid_testing
Filter
Environment History Connections Git Tutorial
Import Dataset
273 MiB
List
R
Global Environment
Files Plots Packages Help Viewer Presentation
Folder Blank File Upload Delete Rename
Cloud > project > exercises
Console Terminal Jobs
R 4.1.3 · /cloud/project/

Filter can search variables

	test_id	clinic_name	result	demo_group	age	drive_thru_ind	ct_value
	All	All	osit	All	All	All	All
10	covid	inpatient ward b	positive	patient	0.9	0	39.55
11	covid	clinical lab	positive	misc adult	21.0	1	39.51
11	covid	s care ntwk	positive	patient	0.1	0	39.83
12	covid	emergency dept	positive	patient	0.1	0	32.96
12	covid	emergency dept	positive	patient	18.0	0	31.16
12	covid	hem onc day hosp	positive	patient	1.0	0	29.04
12	covid	emergency dept	positive	patient	18.0	0	30.07
13	covid	oncology day hosp	positive	patient	1.0	0	35.69

Showing 1 to 8 of 865 entries, 17 total columns (filtered from 15,524 total entries)

Shows rows meeting criteria

Data

covid_testing 15524 obs. of 17 variables

```
> covid_testing <- read_csv("covid_testing.csv")
Rows: 15524 Columns: 17
── Column specification ────────────────────────────────
Delimiter: ","
chr (9): first_name, last_name, gender, test_id, clinic_name, result, d...
dbl (8): mrn, pan_day, age, drive_thru_ind, ct_value, orderset, col_rec...

ℹ Use `spec()` to retrieve the full column specification for this data.
ℹ Specify the column types or set `show_col_types = FALSE` to quiet this message.
> View(covid_testing)
>
```

Name	Size	Modified
..		
02 – Fixing Syntax Mistakes.Rmd	445 B	Oct 19, 2021, 4:26 PM
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05 – Transform.Rmd	3.2 KB	Oct 20, 2021, 11:42 PM
06 – Group by and Summarize.Rmd	4.1 KB	Dec 9, 2021, 3:40 PM
07 – Advanced Reporting.Rmd	942 B	Oct 20, 2021, 11:42 PM
covid_testing.csv	1.7 MB	Oct 19, 2021, 4:26 PM

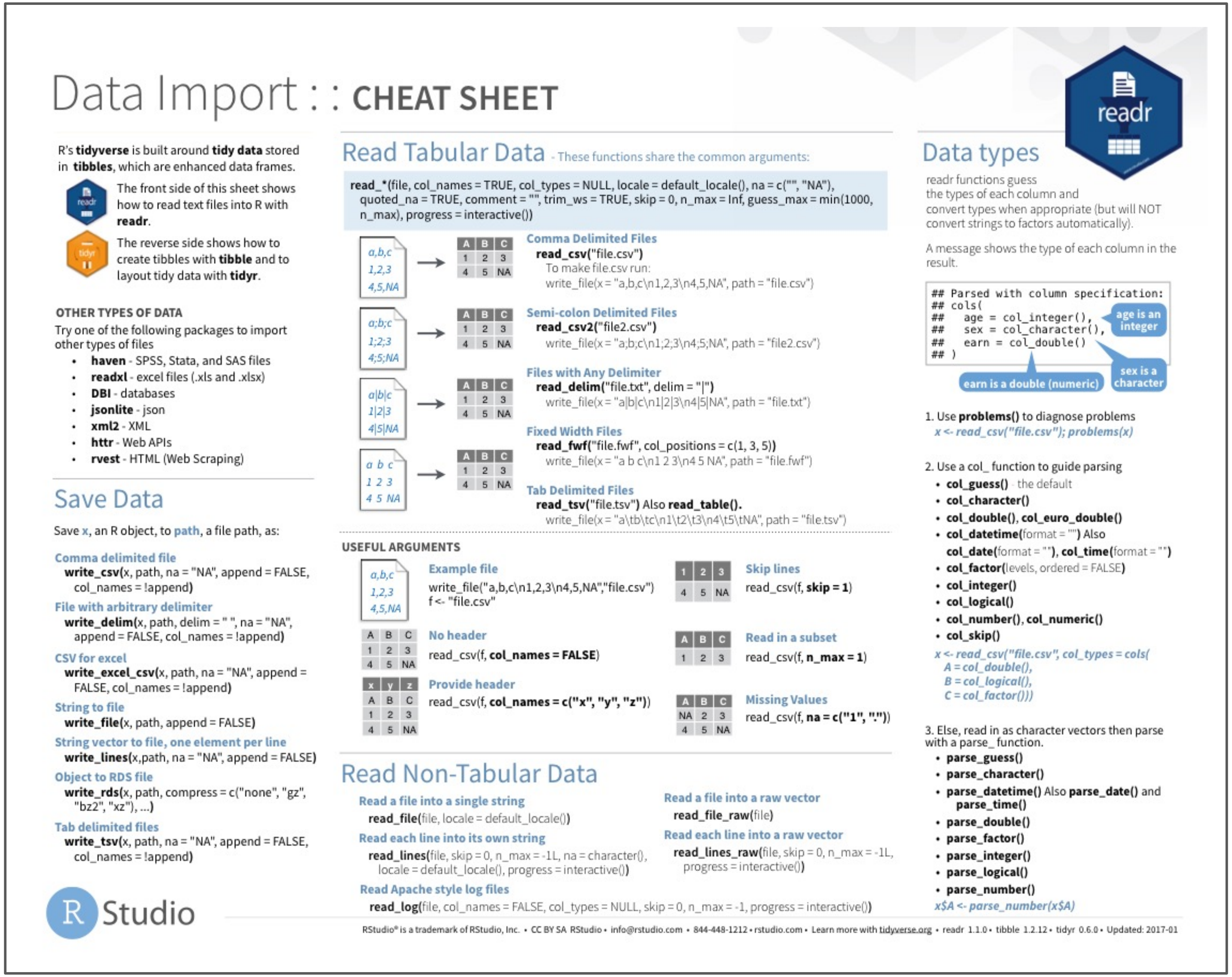
Recap

Functions do stuff. They accept **Arguments** to define parameters. We can store the output of functions in **Objects** using the assignment operator (<-).

Packages extend the functionality of R. They need to be installed once per computer and loaded each session.

Importing Data is the first step data analysis pipeline. read_csv() is a function from the tidyverse that we can use for importing data.

What else?



Data Import : : CHEAT SHEET

R's **tidyverse** is built around **tidy data** stored in **tibbles**, which are enhanced data frames.

The front side of this sheet shows how to read text files into R with **readr**.

The reverse side shows how to create tibbles with **tibble** and to layout tidy data with **tidyr**.

OTHER TYPES OF DATA

Try one of the following packages to import other types of files

- **haven** - SPSS, Stata, and SAS files
- **readxl** - excel files (.xls and .xlsx)
- **DBI** - databases
- **jsonlite** - json
- **xml2** - XML
- **httr** - Web APIs
- **rvest** - HTML (Web Scraping)

Save Data

Save x, an R object, to path, a file path, as:

Comma delimited file
write_csv(x, path, na = "NA", append = FALSE, col_names = !append)

File with arbitrary delimiter
write_delim(x, path, delim = " ", na = "NA", append = FALSE, col_names = !append)

CSV for excel
write_excel_csv(x, path, na = "NA", append = FALSE, col_names = !append)

String to file
write_file(x, path, append = FALSE)

String vector to file, one element per line
write_lines(x,path, na = "NA", append = FALSE)

Object to RDS file
write_rds(x, path, compress = c("none", "gz", "bz2", "xz"), ...)

Tab delimited files
write_tsv(x, path, na = "NA", append = FALSE, col_names = !append)

Read Tabular Data - These functions share the common arguments:

read_*(file, col_names = TRUE, col_types = NULL, locale = default_locale(), na = c("", "NA"), quoted_na = TRUE, comment = "", trim_ws = TRUE, skip = 0, n_max = Inf, guess_max = min(1000, n_max), progress = interactive())

a,b,c
1,2,3
4,5,NA
→

A	B	C
1	2	3
4	5	NA

Comma Delimited Files
read_csv("file.csv")
To make file.csv run:
write_file(x = "a,b,c\n1,2,3\n4,5,NA", path = "file.csv")

a;b;c
1;2;3
4;5;NA
→

A	B	C
1	2	3
4	5	NA

Semi-colon Delimited Files
read_csv2("file2.csv")
write_file(x = "a;b;c\n1;2;3\n4;5;NA", path = "file2.csv")

a|b|c
1|2|3
4|5|NA
→

A	B	C
1	2	3
4	5	NA

Files with Any Delimiter
read_delim("file.txt", delim = "|")
write_file(x = "a|b|c\n1|2|3\n4|5|NA", path = "file.txt")

a b c
1 2 3
4 5 NA
→

A	B	C
1	2	3
4	5	NA

Fixed Width Files
read_fwf("file.fwf", col_positions = c(1, 3, 5))
write_file(x = "a b c\n1 2 3\n4 5 NA", path = "file.fwf")

Tab Delimited Files
read_tsv("file.tsv") Also **read_table().**
write_file(x = "a\tb\tc\n1\t2\t3\n4\t5\tNA", path = "file.tsv")

USEFUL ARGUMENTS

a,b,c
1,2,3
4,5,NA

Example file
write_file("a,b,c\n1,2,3\n4,5,NA","file.csv")
f <- "file.csv"

1	2	3
4	5	NA

Skip lines
read_csv(f, **skip = 1**)

A	B	C
1	2	3
4	5	NA

No header
read_csv(f, **col_names = FALSE**)

A	B	C
1	2	3

Read in a subset
read_csv(f, **n_max = 1**)

x	y	z
A	B	C
1	2	3
4	5	NA

Provide header
read_csv(f, **col_names = c("x", "y", "z")**)

A	B	C
NA	2	3
4	5	NA

Missing Values
read_csv(f, **na = c("1", ".")**)

Read Non-Tabular Data

Read a file into a single string
read_file(file, locale = default_locale())

Read each line into its own string
read_lines(file, skip = 0, n_max = -1L, na = character(), locale = default_locale(), progress = interactive())

Read Apache style log files
read_log(file, col_names = FALSE, col_types = NULL, skip = 0, n_max = -1, progress = interactive())

Read a file into a raw vector
read_file_raw(file)

Read each line into a raw vector
read_lines_raw(file, skip = 0, n_max = -1L, progress = interactive())

Data types

readr functions guess
the types of each column and
convert types when appropriate (but will NOT
convert strings to factors automatically).

A message shows the type of each column in the result.

```
## Parsed with column specification:
## cols(
##   age = col_integer(),
##   sex = col_character(),
##   earn = col_double()
## )
```

age is an integer

earn is a double (numeric)

sex is a character

1. Use **problems()** to diagnose problems
   x <- read_csv("file.csv"); problems(x)

2. Use a col_ function to guide parsing
   - **col_guess()** - the default
   - **col_character()**
   - **col_double()**, **col_euro_double()**
   - **col_datetime**(format = "") Also **col_date**(format = ""), **col_time**(format = "")
   - **col_factor**(levels, ordered = FALSE)
   - **col_integer()**
   - **col_logical()**
   - **col_number()**, **col_numeric()**
   - **col_skip()**

   x <- read_csv("file.csv", col_types = cols(
   A = col_double(),
   B = col_logical(),
   C = col_factor()))

3. Else, read in as character vectors then parse with a parse_ function.
   - **parse_guess()**
   - **parse_character()**
   - **parse_datetime()** Also **parse_date()** and **parse_time()**
   - **parse_double()**
   - **parse_factor()**
   - **parse_integer()**
   - **parse_logical()**
   - **parse_number()**

   x$A <- parse_number(x$A)

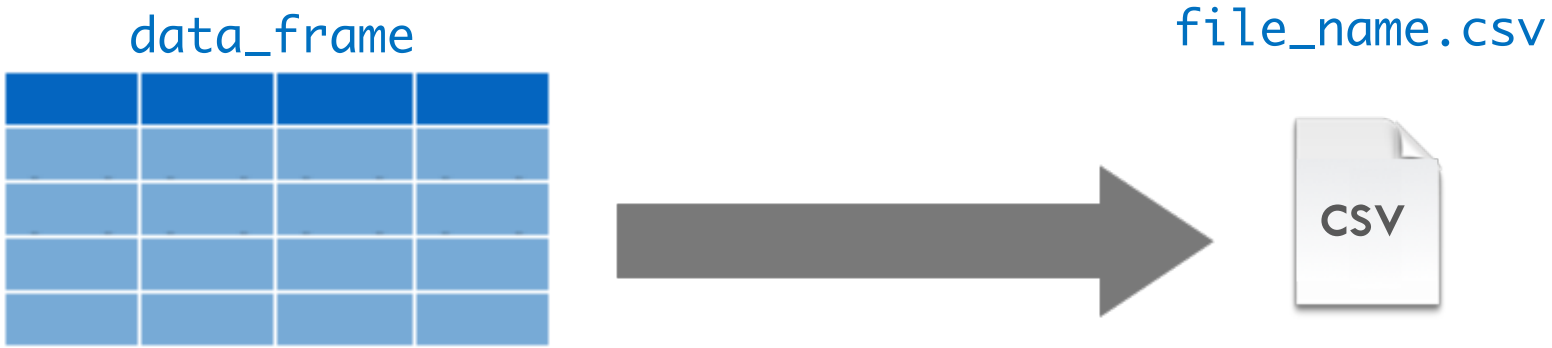
RStudio

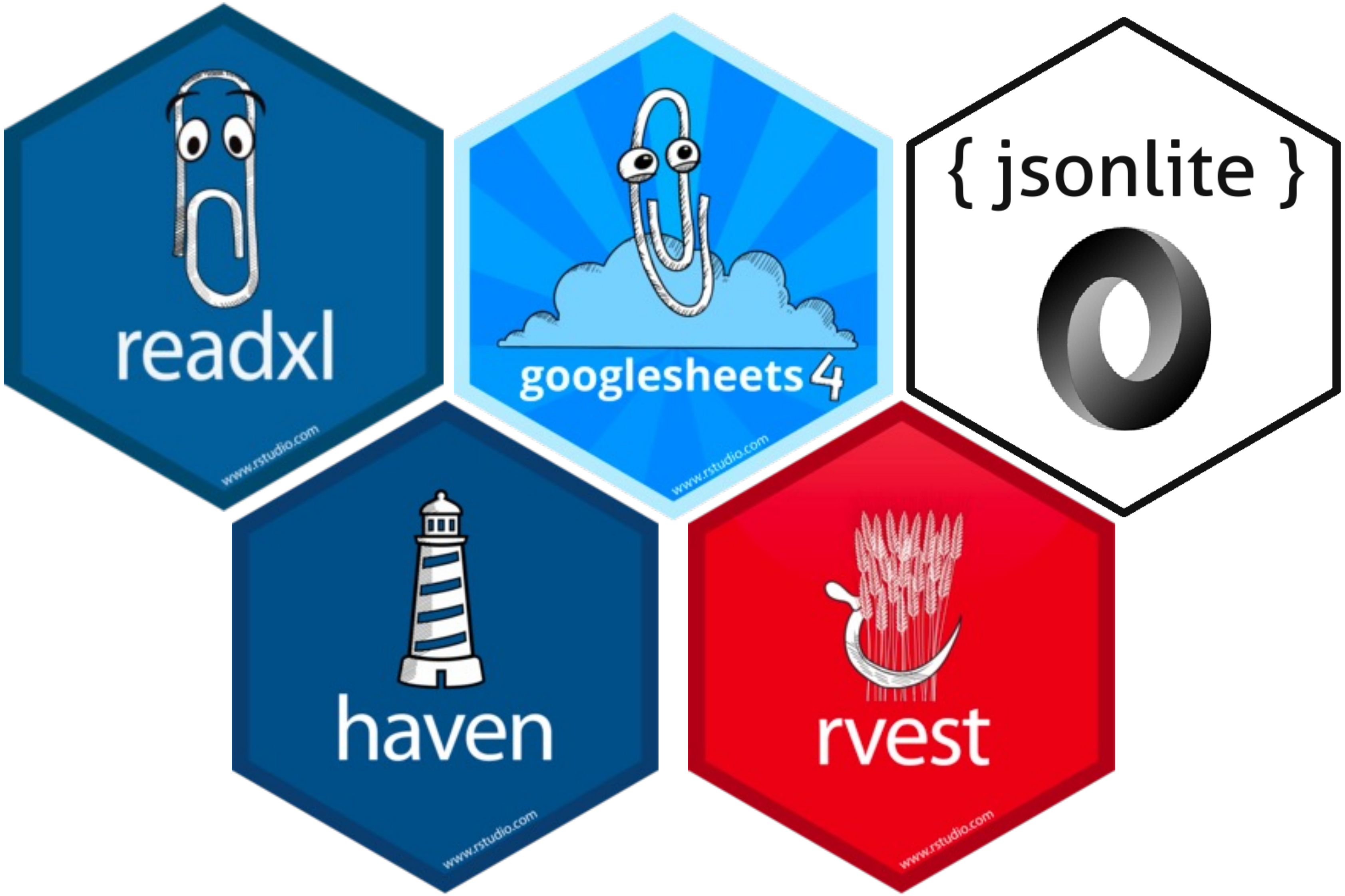
Write data to files

data frame to write file from

name of CSV file to write to

```
write_csv(data_frame, “file_name.csv”)
```




readxl
www.rstudio.com
googlesheets4
www.rstudio.com
{ jsonlite }
haven
www.rstudio.com
rvest
www.rstudio.com

Reading Excel files

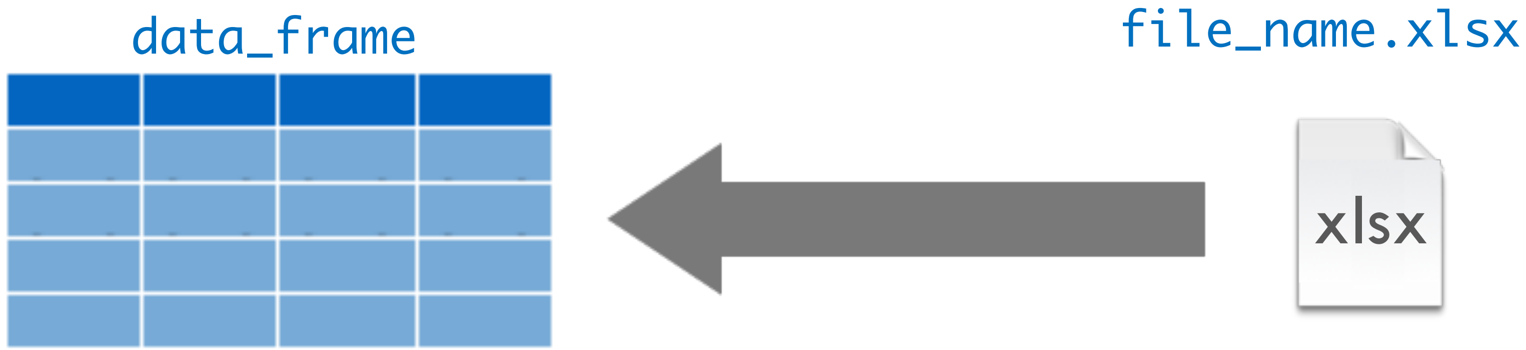
Load package

```
library(readxl)
```

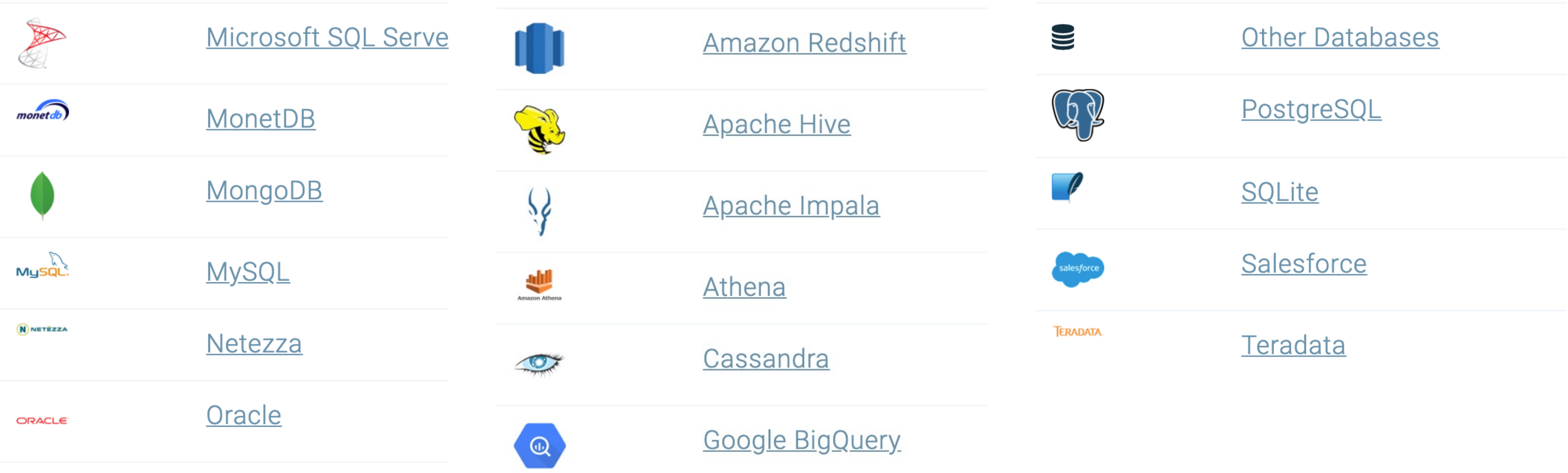
data frame to read data into

name of CSV file

```
data_frame <- read_excel(”file_name.xlsx")
```



Databases



- Microsoft SQL Serve
- MonetDB
- MongoDB
- MySQL
- Netezza
- Oracle
- Amazon Redshift
- Apache Hive
- Apache Impala
- Athena
- Cassandra
- Google BigQuery
- Other Databases
- PostgreSQL
- SQLite
- Salesforce
- Teradata

https://db.rstudio.com/databases/

R Interface to Python

```
library(reticulate)
```

~~~~
```{python}
import pandas
covid_testing.info()
```
~~~~

Lesson Goals

1. Learn some fundamental of coding

Lesson Objectives

1. Define and use functions
2. Define and create objects in the environment
3. Install and load packages
4. Import data into R
5. Interact with a dataframe