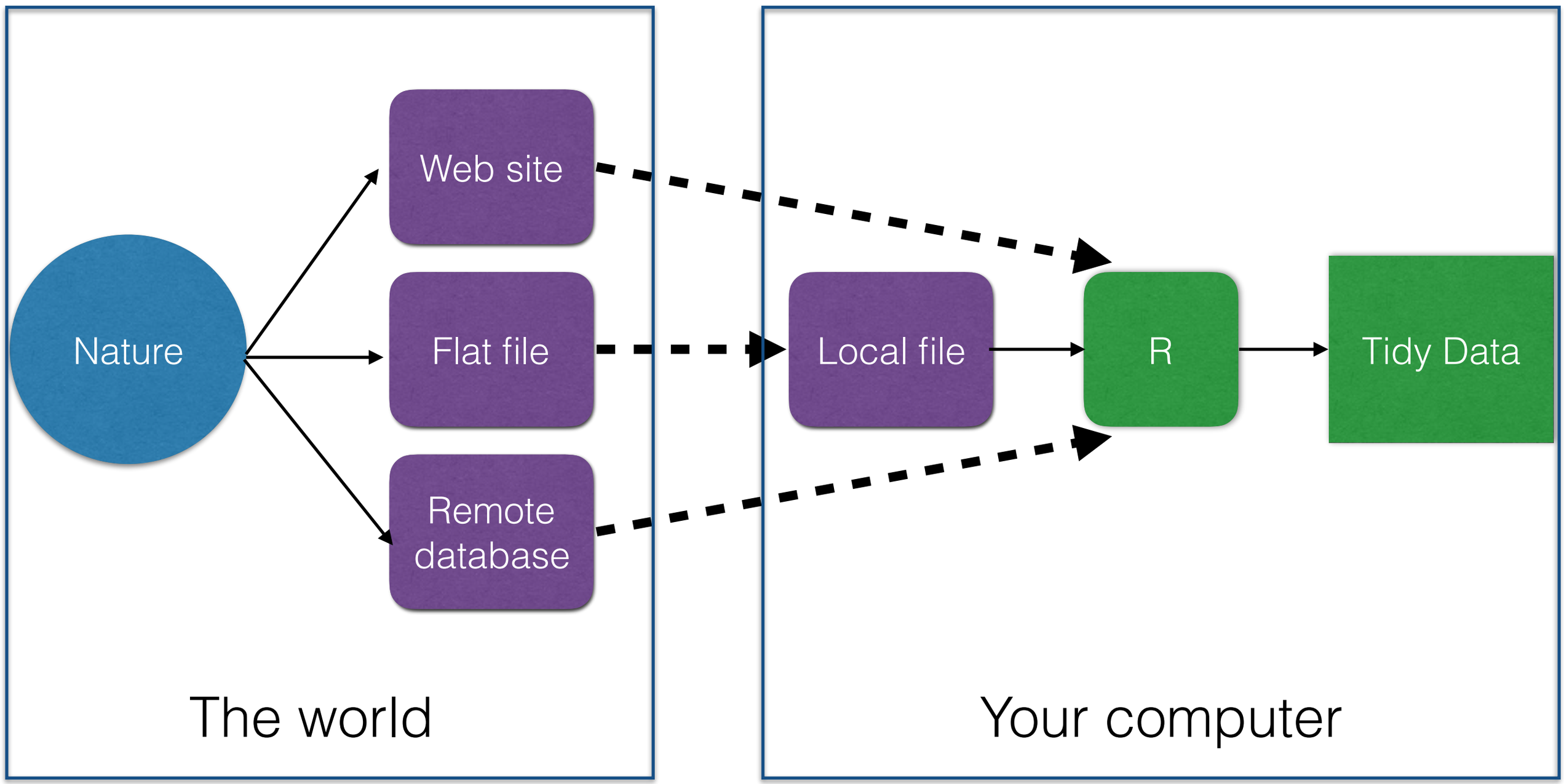
Getting and Cleaning Data

Biostatistics 140.776

Getting and Cleaning Data

- Getting data: APIs and web scraping
- Cleaning data: Tidy data
- Transforming data: Regular expressions

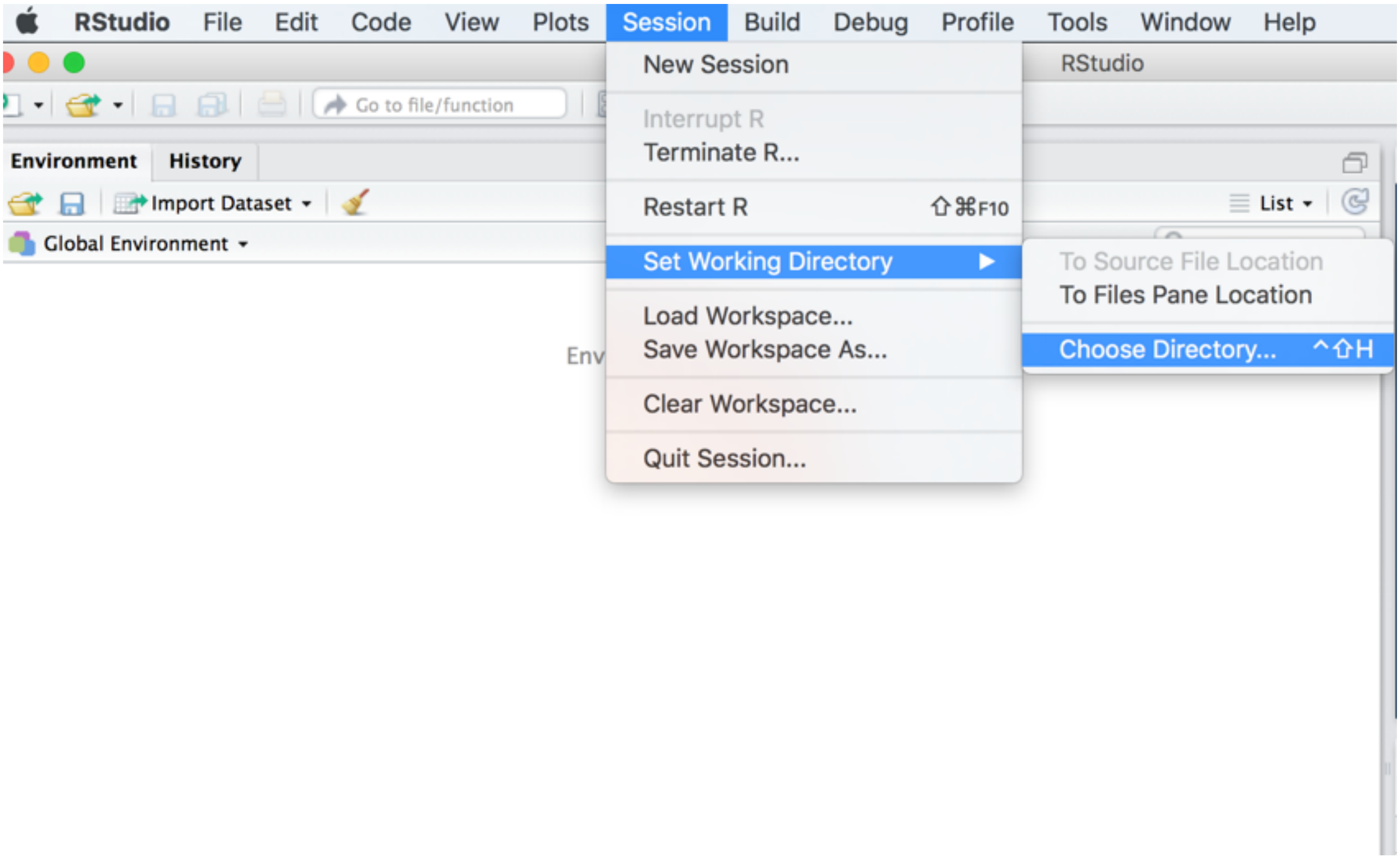
Getting Data



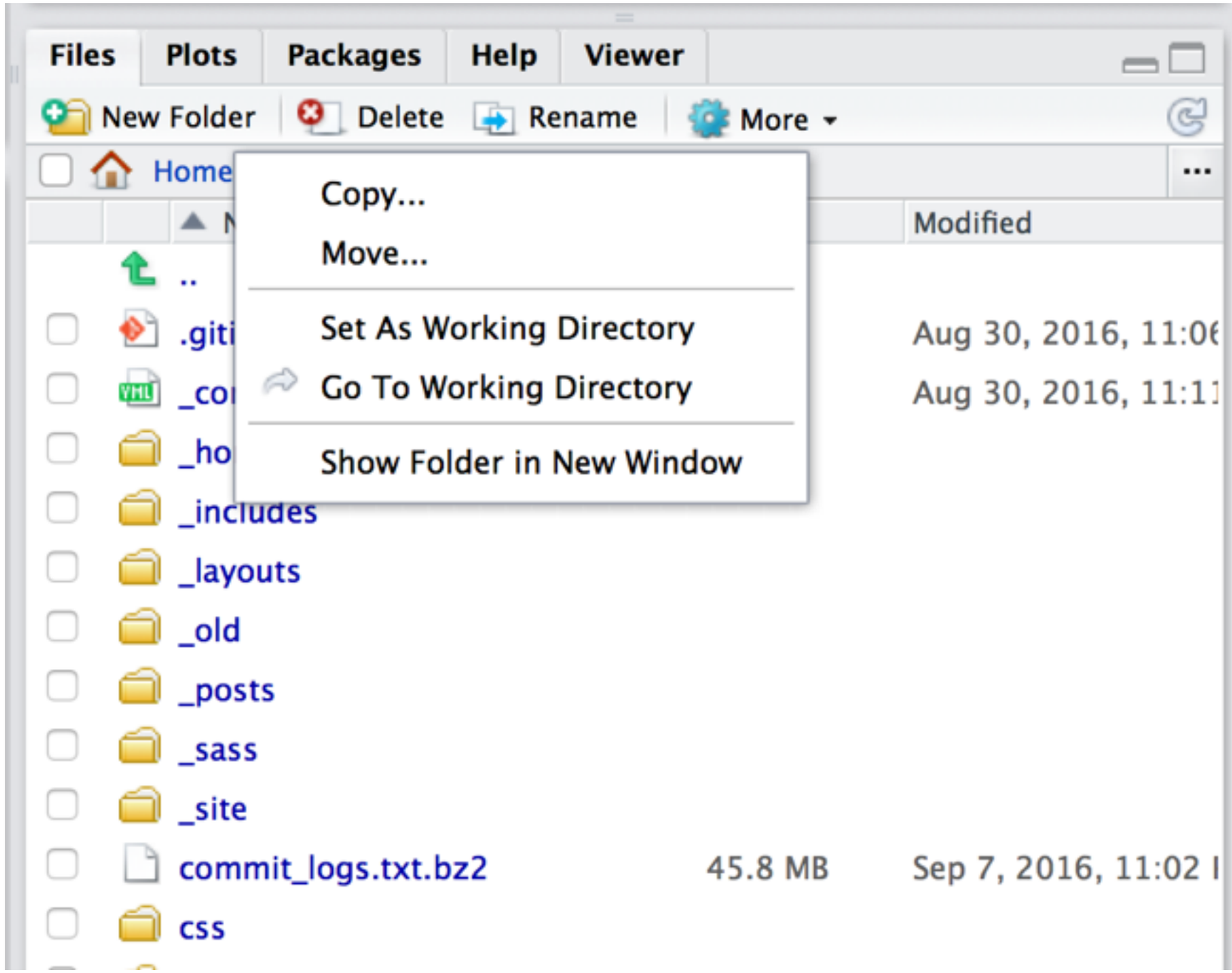
Where Am I?

- The **working directory** is the place where R will look when reading or writing files
- `getwd()` returns the current working directory
- `setwd()` sets the working directory
- RStudio has menu options

Working Directory



Working Directory



Working Directory

- When you download files/data, move them to your working directory
- Upon opening R, **set your working directory** to match whatever project you are working on
- Check with `getwd()`
- You might want to copy the working directory path into your source files

The readr Package

- The functions in the **readr** package can be used to read tabular data from text files
- `read_csv`, `read_table` are the core functions
- All functions are very fast and *can read directly from compressed files*
- You should try to never decompress files that are compressed (not much to be gained)

Flat Files

Particulates

Year	PM2.5 FRM/FEM Mass (88101)	PM2.5 non FRM/FEM Mass (88502)	PM10 Mass (81102)	PM2.5 Speciation
2016	daily_88101_2016.zip 77,865 Rows 932 KB As of 2016-06-17	daily_88502_2016.zip 53,685 Rows 649 KB As of 2016-06-17	daily_81102_2016.zip 30,980 Rows 251 KB As of 2016-06-17	daily_SPEC_2016.zip 92,441 Rows 824 KB As of 2016-06-17
2015	daily_88101_2015.zip 390,090 Rows 4,213 KB As of 2016-06-17	daily_88502_2015.zip 311,901 Rows 3,454 KB As of 2016-06-17	daily_81102_2015.zip 167,829 Rows 1,216 KB As of 2016-06-17	daily_SPEC_2015.zip 1,690,870 Rows 13,061 KB As of 2016-06-17
2014	daily_88101_2014.zip 369,476 Rows 3,979 KB As of 2016-06-17	daily_88502_2014.zip 333,364 Rows 3,675 KB As of 2016-06-17	daily_81102_2014.zip 167,191 Rows 1,221 KB As of 2016-06-17	daily_SPEC_2014.zip 2,108,467 Rows 16,717 KB As of 2016-06-17

http://aqsdrl.epa.gov/aqsweb/aqstmp/airdata/download_files.html

Flat Files

Protocol

URL

```
download.file("http://aqsdrl.epa.gov/aqsweb/aqstmp/airdata/
daily_88101_2016.zip", “PM2.5_2016.zip")
```

Local file name

```
PM2.5_trying URL 'http://aqsdrl.epa.gov/aqsweb/aqstmp/airdata/
daily_88101_2016.zip'
Content type 'application/zip' length 954069 bytes (931 KB)
==================================================
downloaded 931 KB
```

Flat Files

```
## Look inside the zip file (without decompressing it)
unzip("PM2.5_2016.zip", list = TRUE)

                    Name   Length                 Date
1 daily_88101_2016.csv 27720545 2016-07-07 19:35:00

## Read the file (again without decompressing)
library(readr)
d <- read_csv(unz("PM2.5_2016.zip", "daily_88101_2016.csv"))
```

Create connection to zip archive file

Name of zip file

File name within zip archive

Web Sites

Liquor Licenses
(No description provided)

Find in this Dataset

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	LicenseClass	SubClass	LicenseNumber	LicenseDate	LicenseEndDate	LicenseYear	LicenseFee	CertificateNumber	LicenseStatus	LicenseeFirstN
2	LBD7	BWL	243	05/01/2015	04/30/2016	2015	$1,320.00	656	Renewed	SALLY
3	LBD7	BWL	341	05/01/2015	04/30/2016	2015	$1,320.00	924	Renewed	JASON
4	LBD7	BWL	81	05/01/2015	04/30/2016	2015	$1,320.00	224	Renewed	WAYNE
5	LC	BWL	51	05/01/2015	04/30/2016	2015	$550.00	1077	Renewed	EARLE A.
6	LC	BWL	51	05/01/2015	04/30/2016	2015	$550.00	1077	Renewed	JAMES A.
7	LC	BWL	51	05/01/2015	04/30/2016	2015	$550.00	1077	Renewed	JOHN C.
8	LBD7	BWL	304	05/01/2015	04/30/2016	2015	$1,320.00	827	Renewed	FRED A.
9	LBD7	BWL	304	05/01/2015	04/30/2016	2015		827	Renewed	SHIRLEY O.
10	LBD7	BWL	242	05/01/2015	04/30/2016	2015		655	Renewed	ADRIENNE M.
11	LBD7	BWL	242	05/01/2015	04/30/2016	2015	$1,320.00	655	Renewed	TONYA M.
12	AE	AE	16	07/01/2015	06/30/2016	2015	$1,000.00	1286	Renewed	ADRIENNE M.
13	AE	AE	16	07/01/2015	06/30/2016	2015	$1,000.00	1286	Renewed	TONYA M.
14	WD	BW	17	05/01/2015	04/30/2016	2015	$165.00	429	Renewed	ANNE
15	WD	BW	17	05/01/2015	04/30/2016	2015	$165.00	429	Renewed	MILTON J.
16	LA	BWL	88	05/01/2015	04/30/2016	2015	$858.00	356	Renewed	JONG WOONG
17	LA	BWL	88	05/01/2015	04/30/2016	2015	$858.00	356	Renewed	YONG JIN
18	LBD7	BWL	140	05/01/2015	04/30/2016	2015	$1,320.00	386	Renewed	MILTON W.

Look for this

https://data.baltimorecity.gov/City-Services/Liquor-Licenses/xv8d-bwgi

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5	LC	BWL	51	05/01/2015	04/30/2016	2015	$550.00	
6	LC	BWL	51	05/01/2015	04/30/2016	2015	$550.00	
7	LC	BWL	51	05/01/2015	04/30/2016	2015	$550.00	
8	LBD7	BWL	304	05/01/2015	04/30/2016	2015	$1,320.00	
9	LBD7	BWL	304	05/01/2015	04/30/2016	2015	$1,320.00	
10	LBD7	BWL	242	05/01/2015	04/30/2016	2015	$1,320.00	
11	LBD7	BWL	242	05/01/2015	04/30/2016	2015	$1,320.00	
12	AE	AE	16	07/01/2015	06/30/2016	2015	$1,000.00	
13	AE	AE	16	07/01/2015	06/30/2016	2015	$1,000.00	
14	WD	BW	17	05/01/2015	04/30/2016	2015	$165.00	
15	WD	BW	17	05/01/2015	04/30/2016	2015	$165.00	
16	LA	BWL	88	05/01/2015	04/30/2016	2015	$858.00	
17	LA	BWL	88	05/01/2015	04/30/2016	2015	$858.00	
18	LBD7	BWL	140	05/01/2015	04/30/2016	2015	$1,320.00	

Export

SODA API

OData

Print

Download

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Download As

CSV

CSV for Excel

JSON

RDF

RSS

XML

Web Sites

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3	LBD7	BWL	341	05/01/2015	04/30/2016	2015	$1,320.00	
4	LBD7	BWL	81	05/01/2015	04/30/2016	2015	$1,320.00	
5	LC	BWL	51	05/01/2015	04/30/2016	2015	$550.00	
6	LC	BWL	51	05/01/2015	04/30/2016	2015	$550.00	
7	LC	BWL	51	05/01/2015	04/30/2016	2015	$550.00	
8	LBD7	BWL	304	05/01/2015	04/30/2016	2015	$1,320.00	
9	LBD7	BWL	304	05/01/2015	04/30/2016	2015	$1,320.00	
10	LBD7	BWL	242	05/01/2015	04/30/2016	2015	$1,320.00	
11	LBD7	BWL	242	05/01/2015	04/30/2016	2015	$1,320.00	
12	AE	AE	16	07/01/2015	06/30/2016	2015	$1,000.00	
13	AE	AE	16	07/01/2015	06/30/2016	2015	$1,000.00	
14	WD	BW	17	05/01/2015	04/30/2016	2015	$165.00	
15	WD	BW	17	05/01/2015	04/30/2016	2015	$165.00	
16	LA	BWL	88	05/01/2015	04/30/2016	2015	$858.00	
17	LA	BWL	88	05/01/2015	04/30/2016	2015	$858.00	
18	LBD7	BWL	140	05/01/2015	04/30/2016	2015	$1,320.00	

Export

SODA API

OData

Print

Download

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Download As

CS

CS

JS

RD

RS

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Read a File from Web

```
library(readr)

## Read directly off the web site
liquor <- read_csv("https://data.baltimorecity.gov/api/views/xv8d-bwgi/
rows.csv?accessType=DOWNLOAD")

## Note the date/time data were downloaded
Sys.time()
```

Reading Remote Data

- Functions in the **readr** package (`read_csv`, `read_table`, etc.) can all read directly off the web
- Whether to retain static file or read dynamically off the web depends on application
- Truly “dynamic” applications (continuously updated) should probably read directly off web
- When you need a snapshot (e.g. for reproducibility), better to download a static file and read locally

Reading Other Files

- The **readxl** package can be used to read Microsoft Excel files (via the `read_excel` function)
- The **xlsx** can also be used (via read.xlsx function) but requires Java and sometimes doesn't install
- The **haven** package can read files from other stats packages (`read_dta`, `read_sas`, `read_spss`)
- Also, the **foreign** package can read from a few other systems

There’s a Package for That

- 9114 packages on CRAN
- **googlesheets**: Reading Google Sheets table data
- **jpeg**, **png**: Reading bitmap image data
- **rgdal**, **raster**, **shapefiles**: GIS data
- **tuneR**, **seewave**: Music/Sound data
- **RMySQL**, **SQLite**: Relational databases

When in Doubt…

The `read_lines` function just reads lines of text

```
library(readr)

## Read lines from a text file (commit logs)
logs <- read_lines("commit_logs_nomerge.txt")

## See the first few lines of text
head(logs)
[1] "commit 7f6ef08e80191712a5eb0d75c42931466e7bbe73"
[2] “Author: XXXXXXXXXX"
[3] "Date:   Wed Oct 1 16:55:12 2014 -0400"
[4] ""
[5] "    date changes to pages/tickets"
[6] ""
```

Raw Text Data

- Useful for taking a peek at data because no processing is done on read-in
- Use text processing tools (regular expressions) to convert to tidy data
- Lots of back and forth between examining the **structure** of text data and manipulating that structure
- Structured data, like XML, has its own packages for reading and processing

Goal: Tidy Data

- Allows for easy manipulation, transformation, and summary of data
- Required format for most modeling functions (`lm`, `glm`, etc.)
- Makes plotting data in various layouts/formats easier (i.e. with **ggplot2** package)
- Everything is easier!

Tidy Data

- Each variable forms a column.
- Each observation forms a row.
- Each type of observational unit forms a table.

https://www.jstatsoft.org/article/view/v059i10

Tidy Data

	Rural Male	Rural Female	Urban Male	Urban Female
50-54	11.7	8.7	15.4	8.4
55-59	18.1	11.7	24.3	13.6
60-64	26.9	20.3	37.0	19.3
65-69	41.0	30.9	54.6	35.1
70-74	66.0	54.3	71.1	50.0

VADeaths dataset

Tidy Data

```
        age  urban gender death_rate
    <fctr> <fctr> <fctr>      <dbl>
1   50-54  Rural   Male       11.7
2   55-59  Rural   Male       18.1
3   60-64  Rural   Male       26.9
4   65-69  Rural   Male       41.0
5   70-74  Rural   Male       66.0
6   50-54  Rural Female        8.7
7   55-59  Rural Female       11.7
```

Tidyverse

- A series of packages that allow one to easily work with or create tidy data
- The **tidyr** package has tools for manipulating “wide” and “long” format data
- Many other packages in tidyverse depend on tidy data format: **dplyr**, **ggplot2**

Summary

- Identify data locations and tools for reading
- Download files to **working directory**
- Read data directly off the web (sometimes)
- Get data into tidy format