R workshop

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R workshop

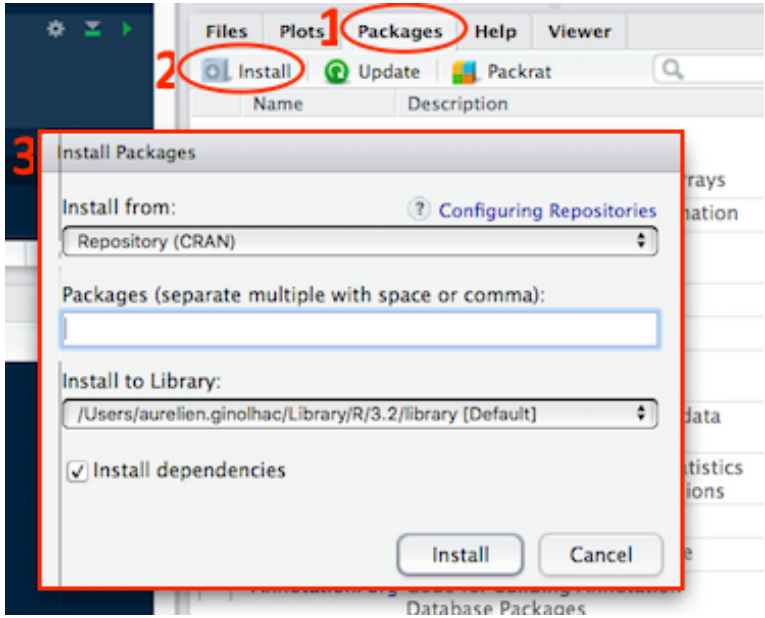
Day 1 - beginner

Why learn R?

- Free!
- Packages
- Community
- `#rstats` on twitter
- rbloggers
- stackoverflow with a lot of tags like `dplyr`, `ggplot2` etc

Packages

- CRAN



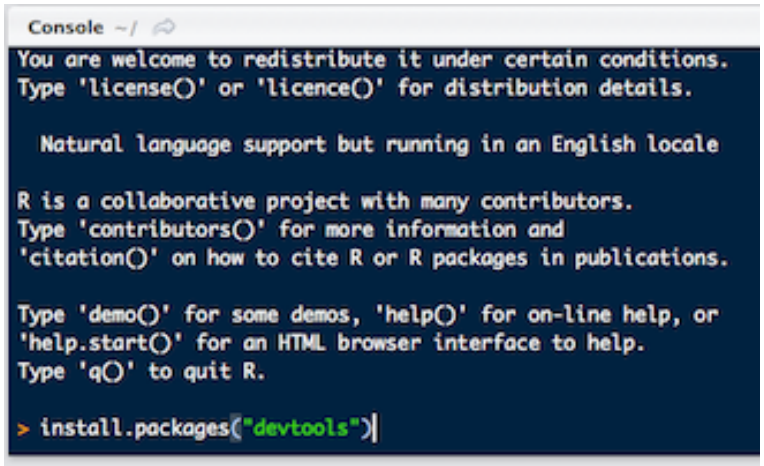
- GitHub using devtools.

```
# install.packages("devtools")
```

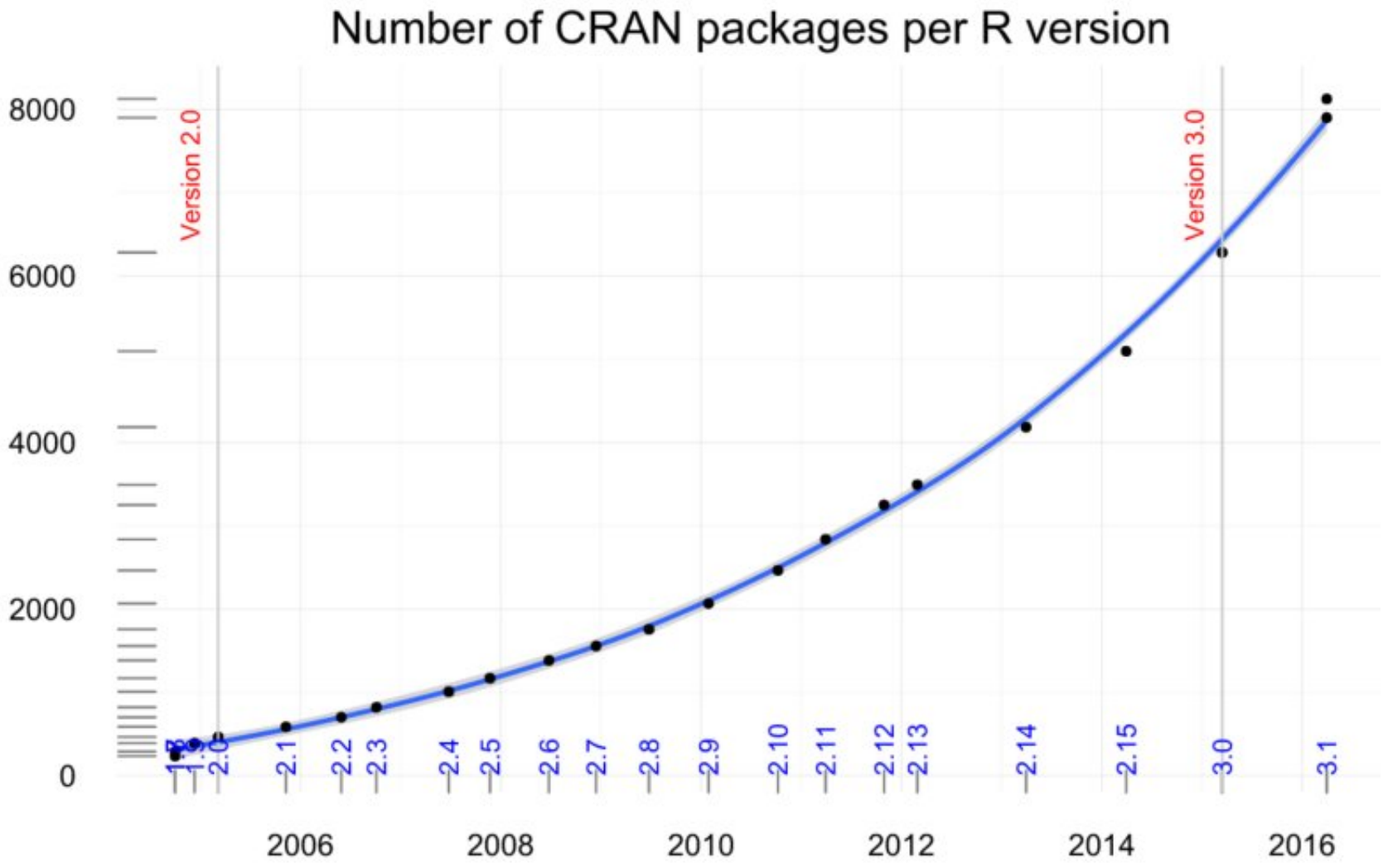
```
devtools::install_github("hadley/readr")
```

- bioconductor.

```
source("https://bioconductor.org/biocLite.R")
biocLite("limma")
```

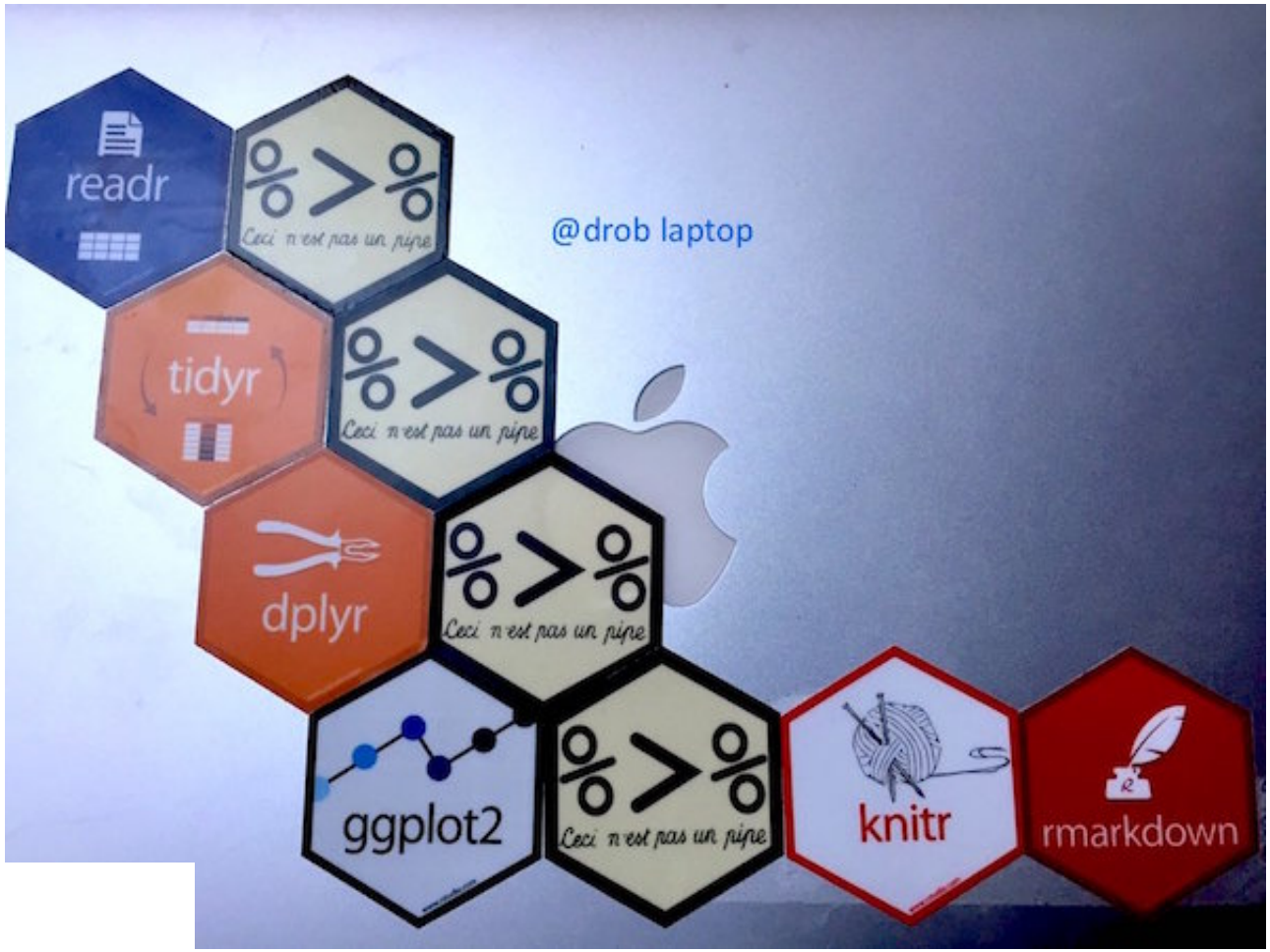


More and more packages



Pipeline goal

David Robinson summarized the workflow on his laptop



Period of much suckiness

Hadley Wickham's "dplyr" tutorial at useR 2014 (1/2)

Period of much suckiness

Whenever you're learning a new tool, for a long time you're going to suck…
But the good news is that it's typical, that's something that happens to everyone, and it's only temporary.
– Hadley Wickham

R data structures

1 dimension: atomic vector

atomic vector source

concatenate elements of **same** type

```
x <- c(1, 1.24, "6")
x
## [1] "1"    "1.24" "6"
is.vector(x)
## [1] TRUE
x[1] # access 1st element
## [1] "1"
```

See if we enter 6 as **character**

```
x <- c(1, 1.24, "6")
x
## [1] "1"    "1.24" "6"
is.vector(x)
## [1] TRUE
is.list(x)
## [1] FALSE
is.atomic(x)
## [1] TRUE
```

1 dimension, lists

Lists are objects that could contain anything

```
l <- list(a = 1:3, b = c("hello", "bye"), data = head(iris, 2))
is.vector(l)
```

```
## [1] TRUE
```

```
is.list(l)
```

```
## [1] TRUE
```

```
is.atomic(l)
```

```
## [1] FALSE
```

```
l[1]
```

```
## $a
```

subsetting

vector

```
x
## [1] "1"    "1.24" "6"
x[1]
## [1] "1"
x[-2] # return 1st and 3rd elements
## [1] "1" "6"
x[c(1, 3)] # return 1st and 3rd elements
## [1] "1" "6"
```

list

```
l[2]      # return a list
## $b
## [1] "hello" "bye"
l[2][1]   # makes no sense
## $b
## [1] "hello" "bye"
l[[2]]    # return a vector
## [1] "hello" "bye"
l[[2]][1] # return 1st element, 2nd atomic vector
## [1] "hello"
```

Accessing lists' elements

2 dimensions: homogenous elements

`matrix`

```
matrix(data = 1:6, nrow = 2, ncol = 3)
```

```
##      [,1] [,2] [,3]
## [1,]    1    3    5
## [2,]    2    4    6
```

2 dimensions: data frames

which are `lists` where all columns have **equal** length

```
class(iris)
## [1] "data.frame"
class(unclass(iris))
## [1] "list"
```

Actually, better to use `tbl_df` rstudio blog

`data_frame()` does much less than `data.frame()`:

- never changes the type of the inputs (it never converts strings to factors!)
- never changes the names of variables
- never creates row.names()
- never print ALL rows

but display

- column types
- groups (`dplyr::group_by()`)

subsetting data frames

data frame are lists

```
mtcars[[1]]
```

```
##  [1] 21.0 21.0 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 17.8 16.4 17.3 15.2
## [15] 10.4 10.4 14.7 32.4 30.4 33.9 21.5 15.5 15.2 13.3 19.2 27.3 26.0 30.4
## [29] 15.8 19.7 15.0 21.4
```

```
mtcars["mpg"]
```

```
##  [1] 21.0 21.0 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 17.8 16.4 17.3 15.2
## [15] 10.4 10.4 14.7 32.4 30.4 33.9 21.5 15.5 15.2 13.3 19.2 27.3 26.0 30.4
## [29] 15.8 19.7 15.0 21.4
```

but `$` is a shorthand for `[[`

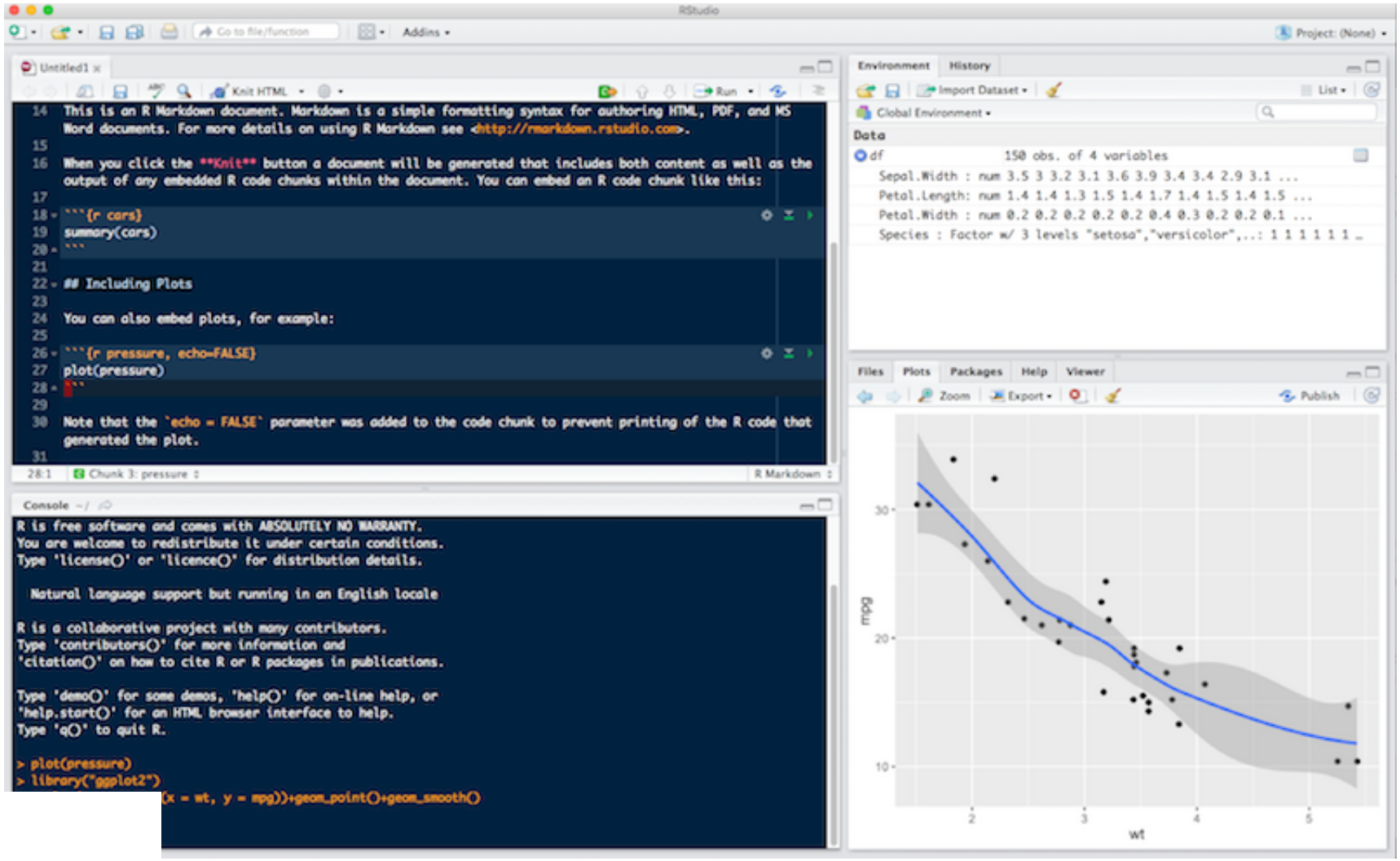
```
mtcars$mpg
```

```
##  [1] 21.0 21.0 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 17.8 16.4 17.3 15.2
## [15] 10.4 10.4 14.7 32.4 30.4 33.9 21.5 15.5 15.2 13.3 19.2 27.3 26.0 30.4
```

Rstudio

Integrated Development Editor

Layout, 4 panels



Features

- Package management (including building)
- Console to run R, with syntax highligther
- Editor to work with scripts / markdown
- auto-completion using TAB
- Cheatsheets
- Keyboard shortcuts

Cmd + Enter (mac) or Ctrl + Enter (PC): sends the line or selection from the editor to the console and runs it.

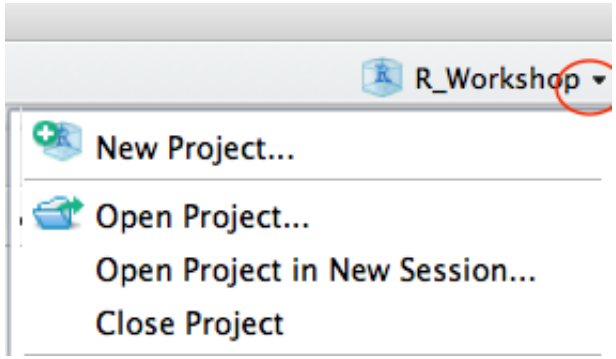
↑: in the console browse previous commands

Update options

Recommended in the r4ds To get a clean environment at start-up

Projects

Solve most issues with working directories, get rid of `setwd()`



Chaining

The pipe operator %>%

magrittr by Stefan Milton Bache

Compare:

```
set.seed(124)
x <- rnorm(10)
mean(x)
```

```
## [1] 0.2147669
```

```
round(mean(x), 3)
```

```
## [1] 0.215
```

with:

```
set.seed(124)
rnorm(10) %>% mean %>% round(3)
```

```
## [1] 0.215
```

Easier to read

natural from left to right.

Even better with **one** instruction per line and **indentation**

```
set.seed(124)
rnorm(10) %>%
  mean %>%
  round(3)
```

```
## [1] 0.215
```

Tidying data

tidyr

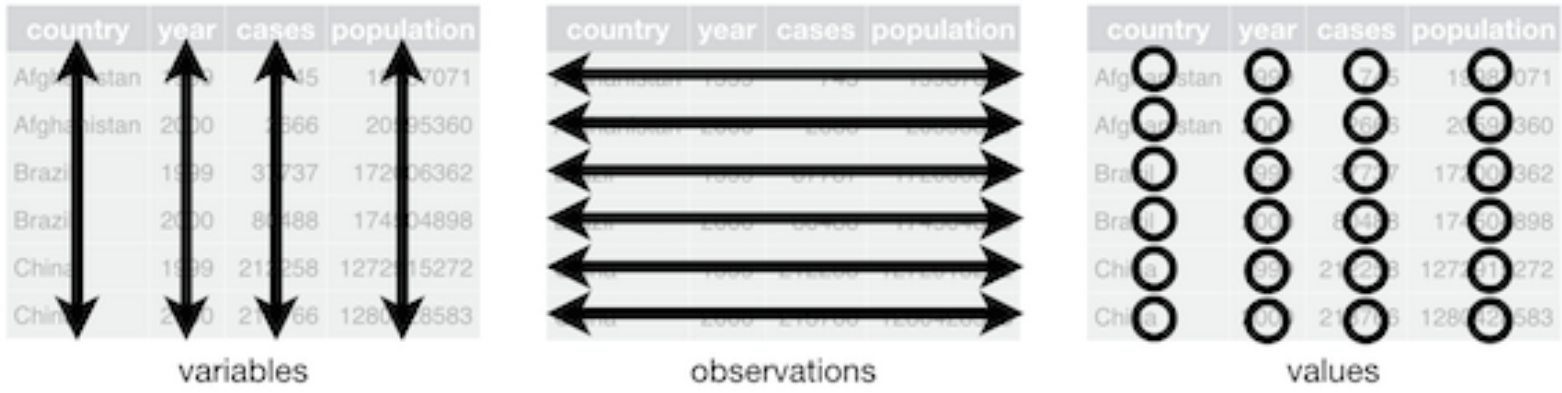
Definitions

- **Variable**: A quantity, quality, or property that you can measure.
- **Observation**: A set of values that display the relationship between variables. To be an observation, values need to be measured under similar conditions, usually measured on the same observational unit at the same time.
- **Value**: The state of a variable that you observe when you measure it.

source: Garret Grolemund

Rules

1. Each variable is in its own column
2. Each observation is in its own row
3. Each value is in its own cell



Convert Long / wide format

The wide format is generally untidy found in the majority of datasets

country	year	cases
Afghanistan	1999	745
Afghanistan	2000	2666
Brazil	1999	37737
Brazil	2000	80488
China	1999	212258
China	2000	213766

country	1999	2000
Afghanistan	745	2666
Brazil	37737	80488
China	212258	213766

table4

Demo with the iris dataset

```
head(iris, 3)
```

```
##   Sepal.Length Sepal.Width Petal.Length Petal.Width Species
## 1          5.1         3.5          1.4         0.2  setosa
## 2          4.9         3.0          1.4         0.2  setosa
## 3          4.7         3.2          1.3         0.2  setosa
```

gather

```
library("tidyr")
iris_melt <- iris %>%
  tibble::rownames_to_column() %>%
  dplyr::tbl_df() %>%
  gather(flower, measure, contains("al"))
iris_melt
```

```
## Source: local data frame [600 x 4]
##
##    rowname Species       flower measure
##      <chr>  <fctr>        <chr>   <dbl>
## 1        1  setosa Sepal.Length     5.1
## 2        2  setosa Sepal.Length     4.9
```

spread

```
iris_melt %>%
  spread(flower, measure)
```

```
## Source: local data frame [150 x 6]
##
##    rowname    Species Petal.Length Petal.Width Sepal.Length Sepal.Width
##      <chr>     <fctr>        <dbl>       <dbl>        <dbl>       <dbl>
## 1        1     setosa          1.4         0.2          5.1         3.5
## 2       10     setosa          1.5         0.1          4.9         3.1
## 3      100 versicolor          4.1         1.3          5.7         2.8
## 4      101  virginica          6.0         2.5          6.3         3.3
## 5      102  virginica          5.1         1.9          5.8         2.7
## 6      103  virginica          5.9         2.1          7.1         3.0
## 7      104  virginica          5.6         1.8          6.3         2.9
## 8      105  virginica          5.8         2.2          6.5         3.0
## 9      106  virginica          6.6         2.1          7.6         3.0
## 10     107  virginica          4.5         1.7          4.9         2.5
## ..     ...        ...          ...         ...          ...         ...
```

Separate / Unite

unite

```
df %>%
  unite(date, c(year, month, day), sep = "-") -> df_unite
```

separate, use **quotes** since we are not refering to objects

```
df_unite %>%
  separate(date, c("year", "month", "day"))
```

```
## Source: local data frame [3 x 4]
##
##    year month   day value
##   <chr> <chr> <chr> <chr>
## 1  2015    11    23  high
## 2  2014     2     1   low
## 3  2014     4    30   low
```

Help

using `?` or `help()`

```
?gather
```

or using the `Help` tab next to the `Packages` tab.

Reading data

readr

read_tsv

Guess column types and give **warnings**.

```
library("readr")
soft <- read_tsv("data/GDS5079.soft", skip = 42, na = "null")
```

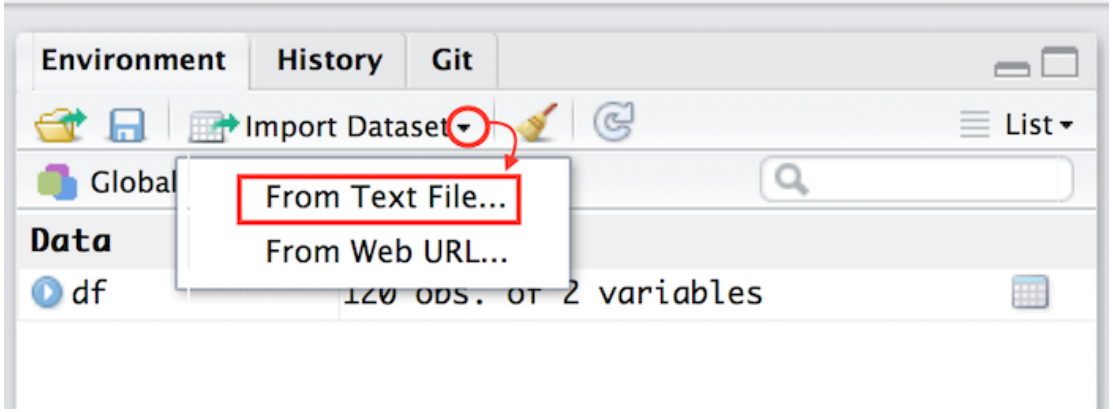
```
## Warning: 2 parsing failures.
##   row      col   expected             actual
## 35557 10344614 an integer !dataset_table_end
## 35557 NA       6 columns  1 columns
```

Viewer utility

```
View(soft)
```

Easier: import file utility

Using `Rstudio`, right top panel. Select directly your **file**. This actually uses **readr**.



overview

Plotting

ggplot2

Why tidy is useful?

```
library("tidyr")
library("ggplot2")
iris %>%
  gather(flower, measure, 1:4) %>%
  ggplot()+
  geom_boxplot(aes(x = Species, y = measure, fill = flower))
```

Scatterplots

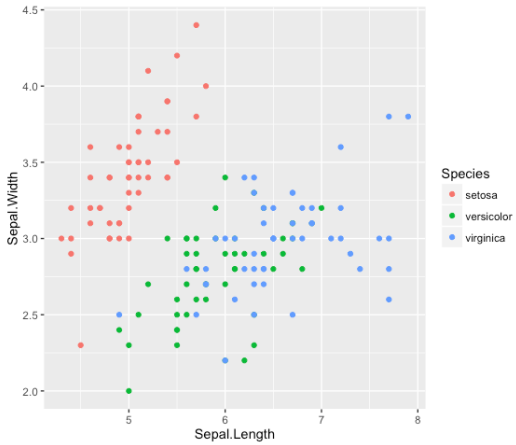
```
iris %>%
  ggplot(aes(x = Sepal.Length, y = Sepal.Width, colour = Species))+
  geom_point()+
  geom_smooth(method = "lm", se = FALSE)+
  xlab("Length")+
  ylab("Width")+
  ggtitle("Sepal")
```

More aesthetics

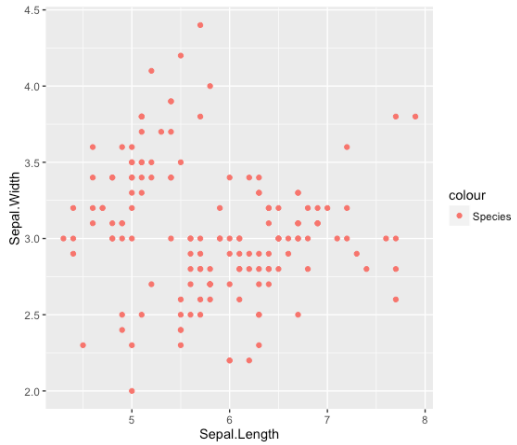
```
iris %>%
  ggplot(aes(x = Sepal.Length, y = Sepal.Width,
             size = Petal.Length / Petal.Width,
             colour = Species))+
  geom_point()+
  scale_size_area("Petal ratio Length / Width")+
  #scale_colour_brewer(palette = 1, type = "qual")+
  scale_colour_manual(values = c("blue", "red", "orange"))+
  xlab("Sepal.Length")+
  ylab("Sepal.Width")
```

in / out aesthetics

```
iris %>%
  ggplot(aes(x = Sepal.Length, y = Sepal.Width))
  geom_point(aes(colour = Species))
```



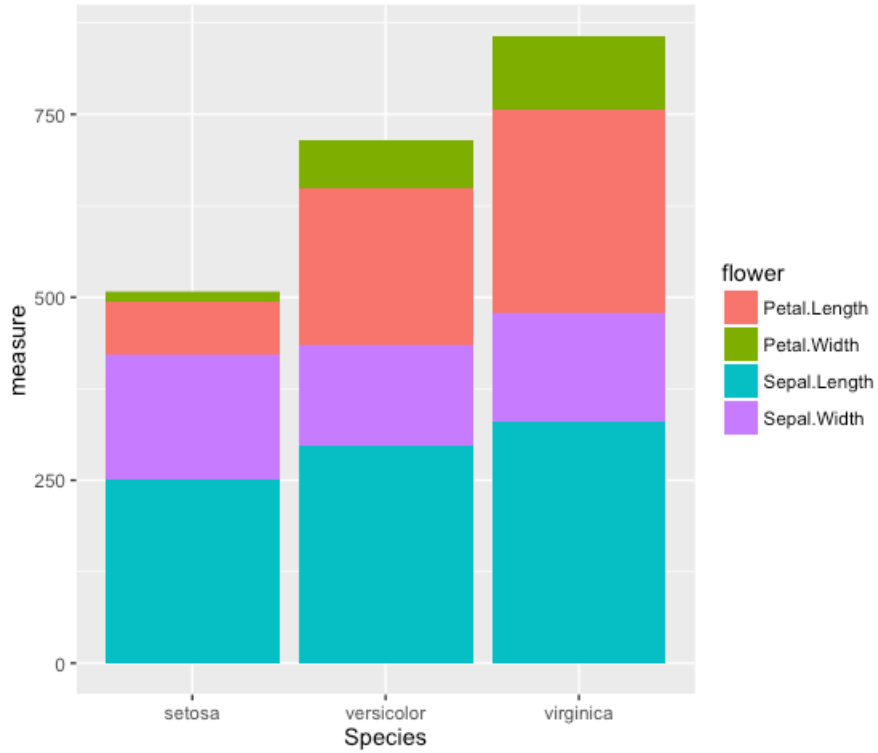

```
iris %>%
  ggplot(aes(x = Sepal.Length, y = Sepal.Width)
  geom_point(aes(colour = "Species"))
```



```
iris %>%
  ggplot(aes(x = Sepal.Length, y = Sepal.Width))+
  geom_point(colour = "red")
```

Barplots

```
iris_melt %>%
  ggplot()+
  geom_bar(aes(x = Species, y = measure, fill = flower), stat = "identity")
```



Density and faceting

transparency using the `alpha` parameter

```
iris_melt %>%
  ggplot()+
  geom_density(aes(x = measure, fill = Species, colour = Species), alpha = 0.6)+
  facet_wrap(~ flower, scale = "free")+
  theme_bw()
```

facetting

transparency using the `alpha` parameter

```
iris_melt %>%
  ggplot()+
  geom_density(aes(x = measure, fill = Species, colour = Species), alpha = 0.6)+
  facet_grid(Species ~ flower, scale = "free")+
  theme_bw()
```

theme

Recommended reading

- data structures by Hadley
- R for data science by Hadley & Garrett
- reading data
- tidy data
- plotting
- ggplot2 documentation by Hadley / Winston
- ggplot2 layer by layer by Hadley
- Excellent ressource on R (in French) Introduction to R by Ewen Gallic

Acknowledgments

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