R for Data Science

@somkiat

Somkiat Puisungnoen

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When did you attend Ubon Ratchathani University?

14 Pending Items

Intro

Software Craftsmanship

- Software Practitioner at สยามชำนาญกิจ พ.ศ. 2556
- Agile Practitioner and Technical at SPRINT3r
- Software analyst at TARAD.com
- Software Developer at True Corporation
- Former Software Engineer at Opendream

Status | Photo/Video | Live Video | Life Event

What's on your mind?

Public | Post

Somkiat Puisungnoen
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พรุ่งนี้ไป share เรื่อง NoSQL ที่มหาวิทยาลัย

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+ Add a Button

Write something...

Personal Blog

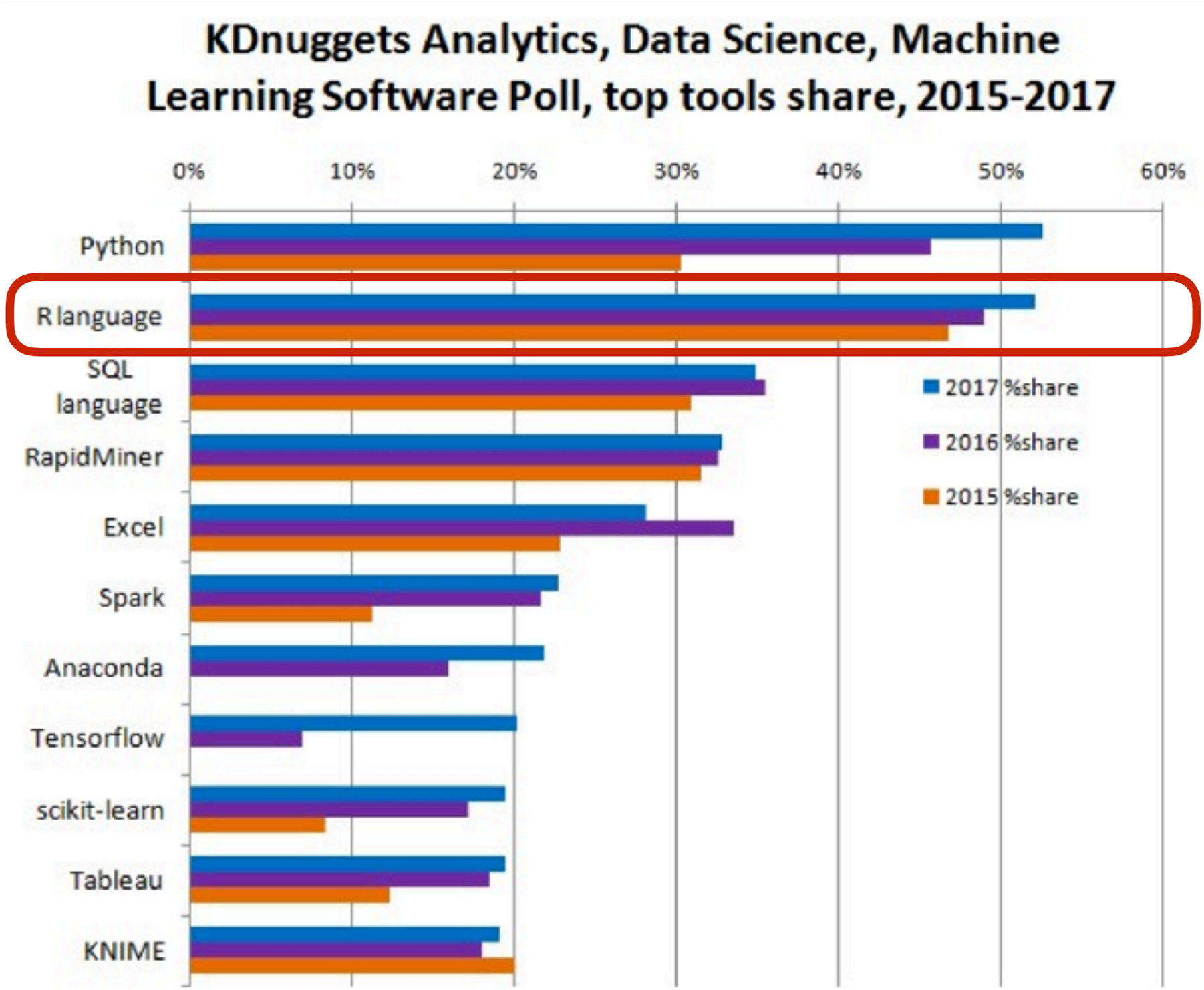
Page Tips — See All

What's a Boosted Post?
A boosted post is the easiest way to reach more people on Facebook.

Top programming 2017

Language Rank	Types	Spectrum Ranking
1. Python		100.0
2. C		99.7
3. Java		99.4
4. C++		97.2
5. C#		88.6
6. R		88.1
7. JavaScript		85.5
8. PHP		81.4
9. Go		76.1
10. Swift		75.3

http://spectrum.ieee.org/static/interactive-the-top-programming-languages-2017



http://www.kdnuggets.com/2017/05/poll-analytics-data-science-machine-learning-software-leaders.html

Try R

http://tryr.codeschool.com/

CHAPTER 1

Try R

In this first chapter, we'll cover basic R expressions. We'll start simple, with numbers, strings, and true/false values. Then we'll show you how to store those values in variables, and how to pass them to functions. We'll show you how to get help on functions when you're stuck. Finally we'll load an R script in from a file.

Let's get started!

Complete to Unlock

http://tryr.codeschool.com/

R programming

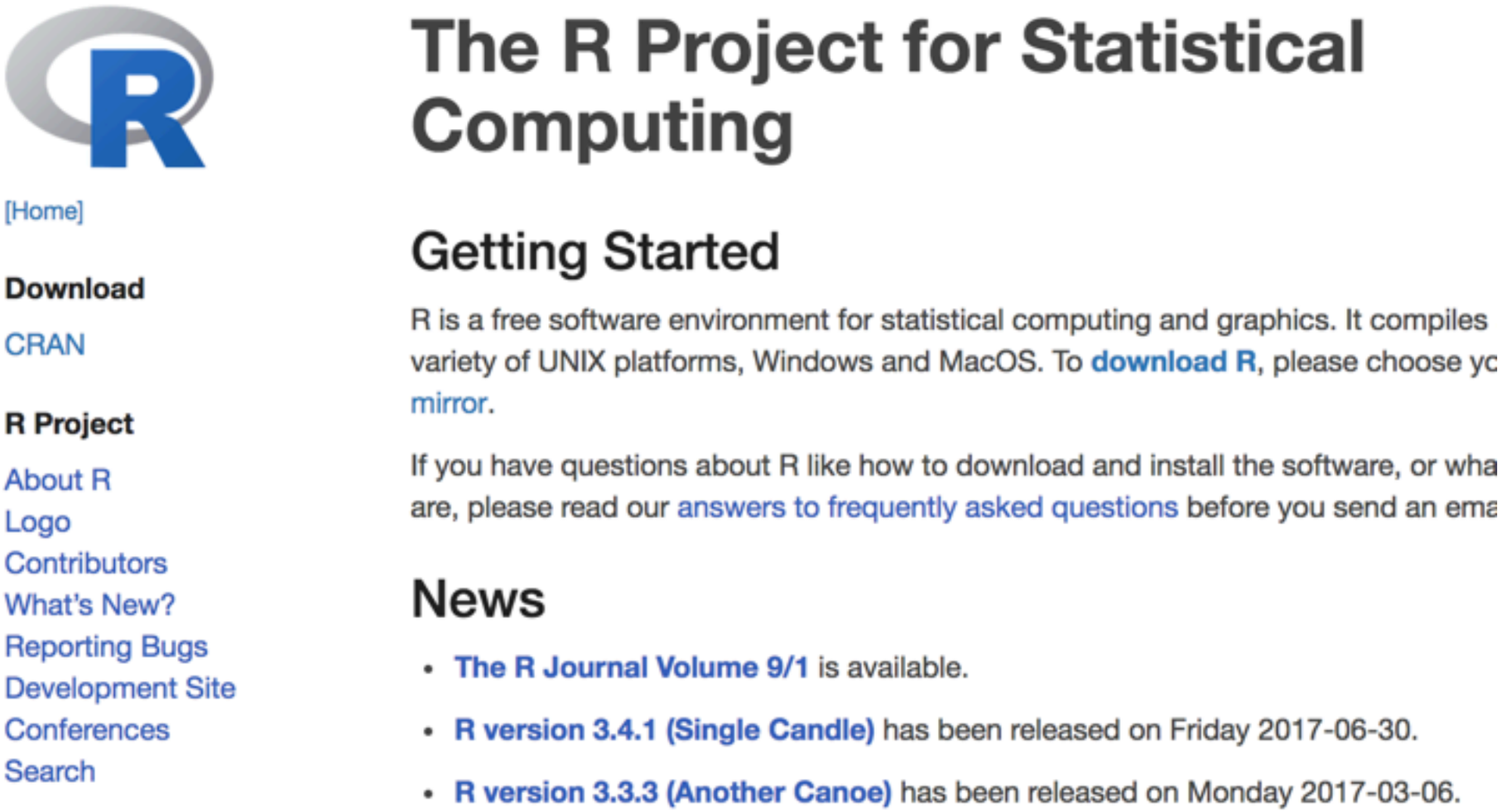
developed from **S** language
Public on 1993

Getting start with **R**

R programming tools

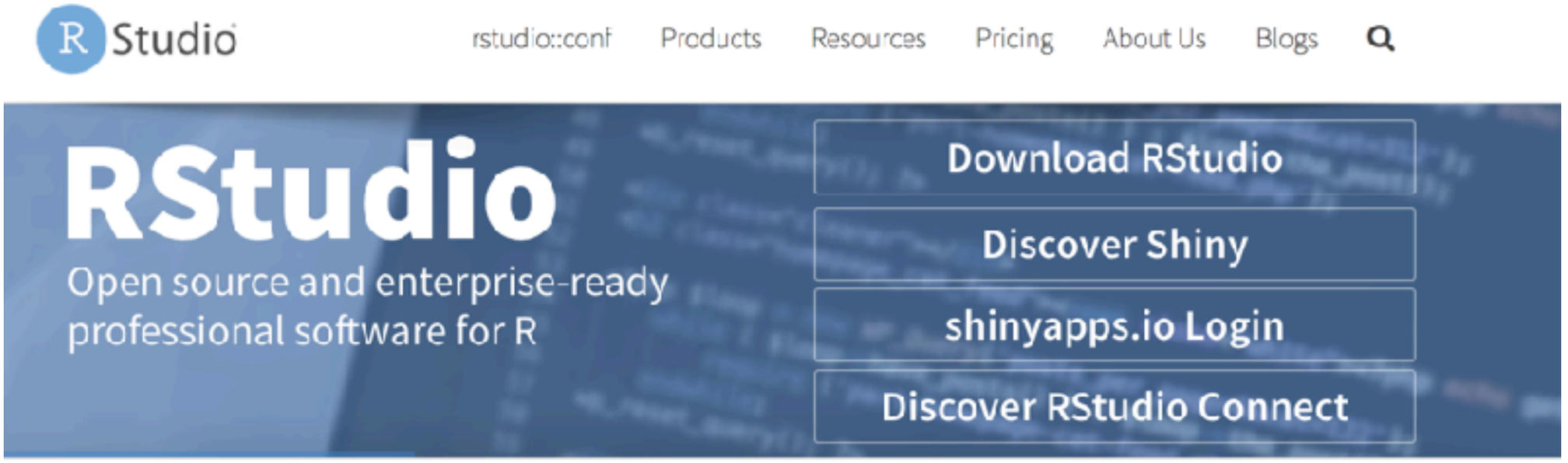
R runtime
R studio
R package

R runtime



https://www.r-project.org/

R studio



RStudio

Shiny

R Packages

https://www.rstudio.com/

R package

Set of functions that perform analysis on some kind of data

R package

CRAN (**C**omprehensive **R** **A**rchive **N**etwork)

Available CRAN Packages By Name

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

A3	Accurate, Adaptable, and Accessible Error Metrics for Predictive Models
abbyyR	Access to Abbyy Optical Character Recognition (OCR) API
abc	Tools for Approximate Bayesian Computation (ABC)
ABCanalysis	Computed ABC Analysis
abc.data	Data Only: Tools for Approximate Bayesian Computation (ABC)
abcdeFBA	ABCDE_FBA: A-Biologist-Can-Do-Everything of Flux Balance Analysis with this package
ABCoptim	Implementation of Artificial Bee Colony (ABC) Optimization
ABCp2	Approximate Bayesian Computational Model for Estimating P2
ABC.RAP	Array Based CpG Region Analysis Pipeline
abcrf	Approximate Bayesian Computation via Random Forests
abctools	Tools for ABC Analyses
abd	The Analysis of Biological Data
abf2	Load Gap-Free Axon ABF2 Files
ABHgenotypeR	Easy Visualization of ABH Genotypes

https://cran.r-project.org

R environment

R in command line

$R —version

```
R version 3.4.1 (2017-06-30) -- "Single Candle"
Copyright (C) 2017 The R Foundation for Statistical Computing
Platform: x86_64-apple-darwin15.6.0 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under the terms of the
GNU General Public License versions 2 or 3.
For more information about these matters see
http://www.gnu.org/licenses/.
```

R in command line

$R

```
R version 3.4.1 (2017-06-30) -- "Single Candle"
Copyright (C) 2017 The R Foundation for Statistical Computing
Platform: x86_64-apple-darwin15.6.0 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
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Type 'license()' or 'licence()' for distribution details.

  Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

>
```
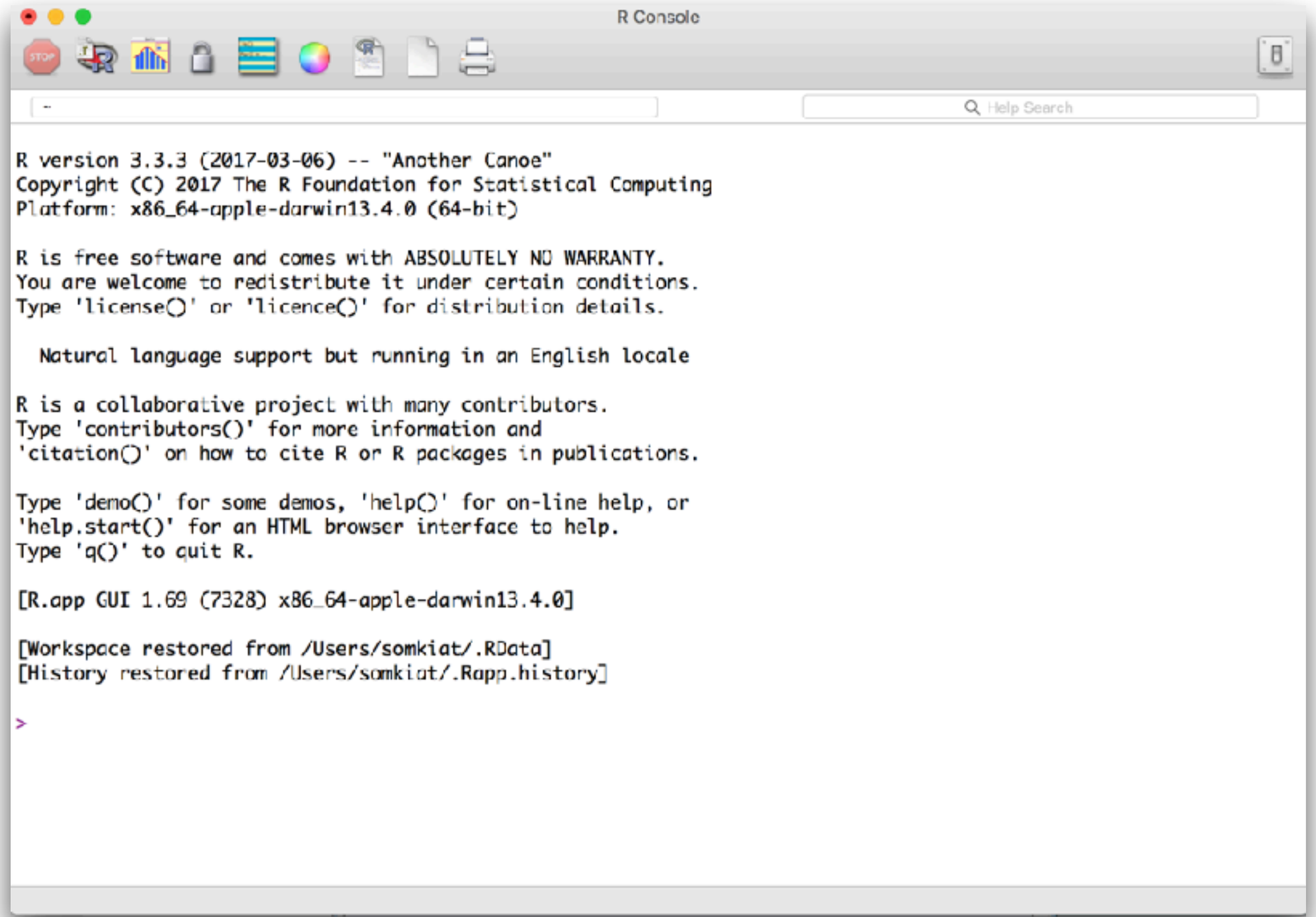

R Script

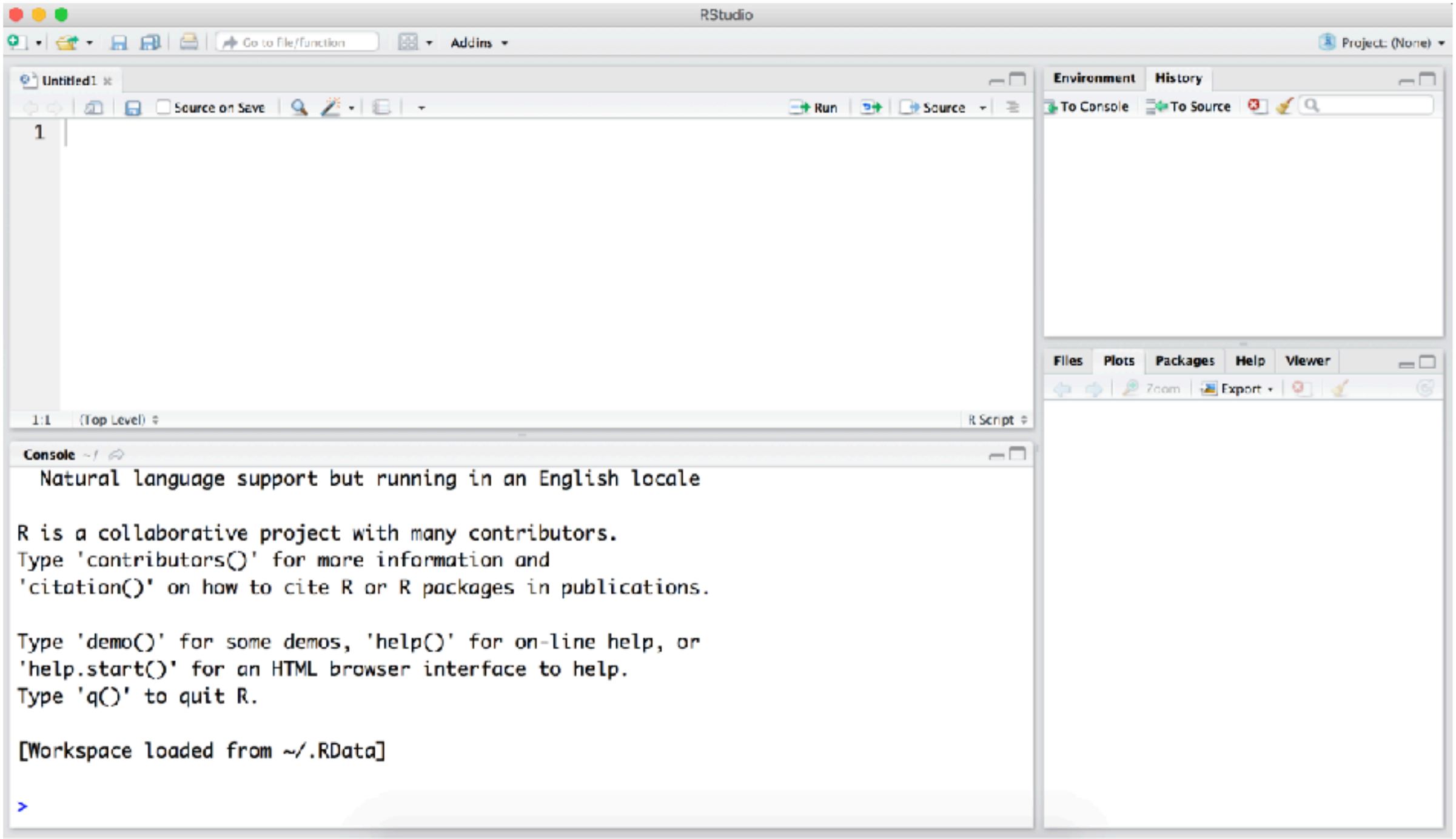
$**Rscript** hello.R

```
sayHello <- function(name){
  cat("Hello ", name)
}

sayHello("R")
```

R console

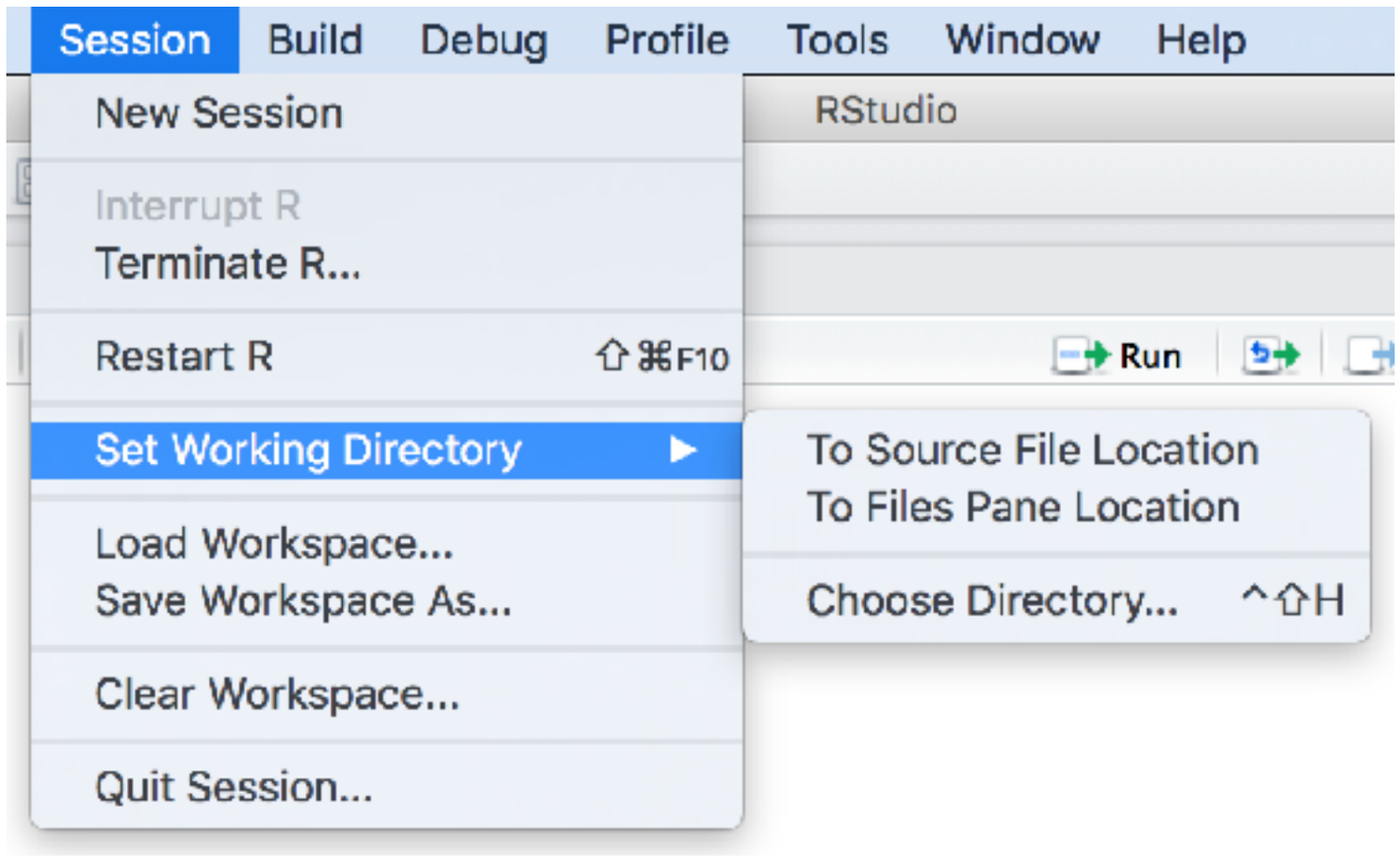

R Console
Help Search
R version 3.3.3 (2017-03-06) -- "Another Canoe"
Copyright (C) 2017 The R Foundation for Statistical Computing
Platform: x86_64-apple-darwin13.4.0 (64-bit)
R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.
Natural language support but running in an English locale
R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.
Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.
[R.app GUI 1.69 (7328) x86_64-apple-darwin13.4.0]
[Workspace restored from /Users/somkiat/.RData]
[History restored from /Users/somkiat/.Rapp.history]
>

R studio


RStudio
Go to file/function
Addins
Project: (None)
Untitled1
Source on Save
Run
Source
1
1:1
(Top Level)
R Script
Environment
History
To Console
To Source
Files
Plots
Packages
Help
Viewer
Zoom
Export
Console ~/
Natural language support but running in an English locale
R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.
Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.
[Workspace loaded from ~/.RData]
>

R studio

Setting workspace of project



Workspace

Current R working environment is a directory

Function	Action
getwd()	List the current working directory
setwd(“your directory”)	Change the current working directory
ls()	List objects in the current workspace
rm(objectlist)	Remove/delete one or more objects
history(#)	Display your last command (default = 25)

Workspace

Function	Action
savehistory(“filename”)	Save the command history to file (default = .Rhistory)
loadhistory(“filename”)	Reload a command history (default = .Rhistory)
save.image(“filename”)	Save the workspace to file (default = .RData)
save(objectlist, file=“filename”)	Save objects to file
load(“filename”)	Load object into current session
q()	Quit R

Working with workspace

```
setwd("your directory")
options()
options(digits=3)
x <- runif(20)
summary(x)
hist(x)
q()
```

R package

12,583 packages

Available Packages

Currently, the CRAN package repository features 12583 available packages.

Table of available packages, sorted by date of publication

Table of available packages, sorted by name

Installation of Packages

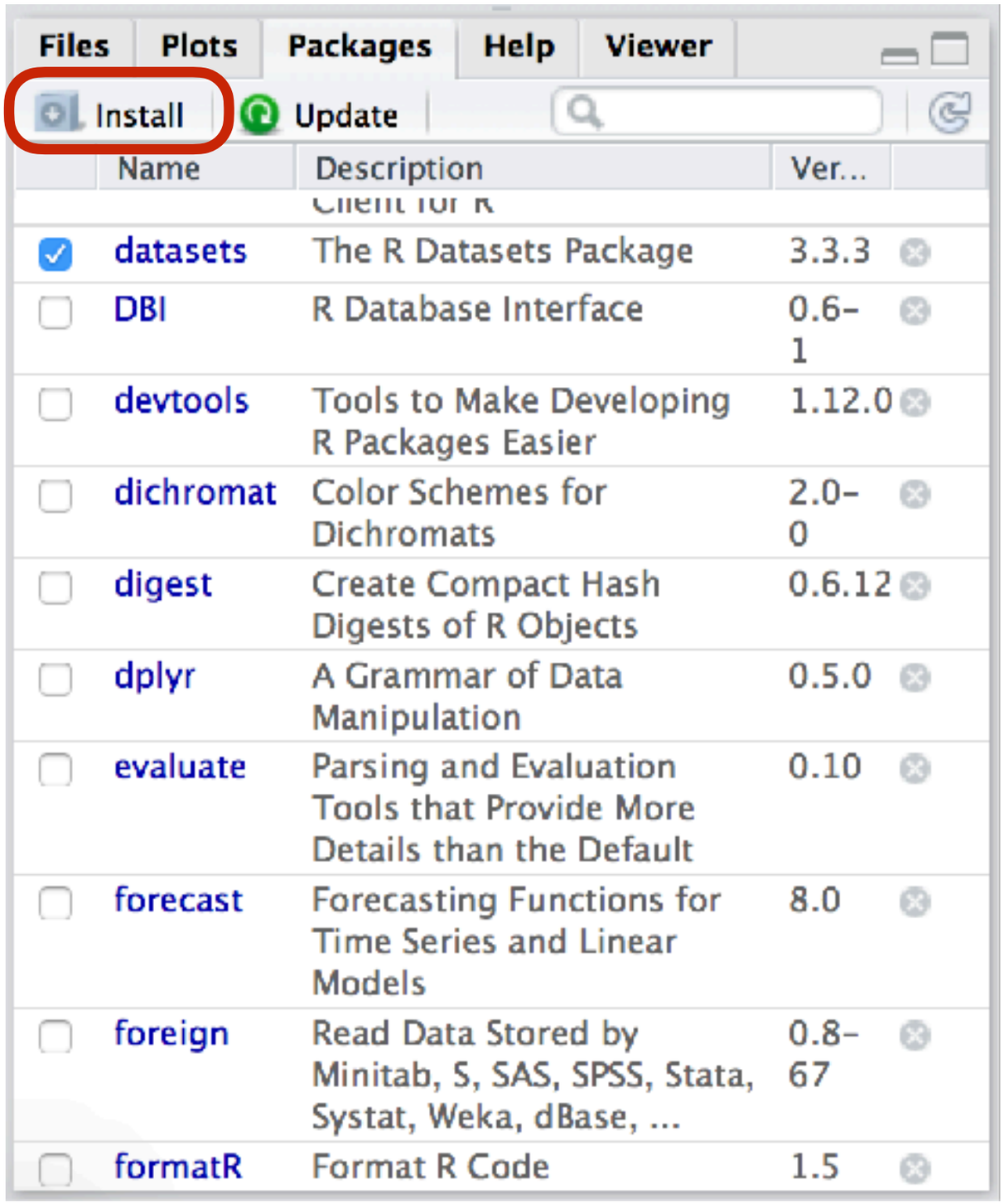
Please type `help("INSTALL")` or `help("install.packages")` in R for informati
the R base sources) explains the process in detail.

https://cran.r-project.org/web/packages/

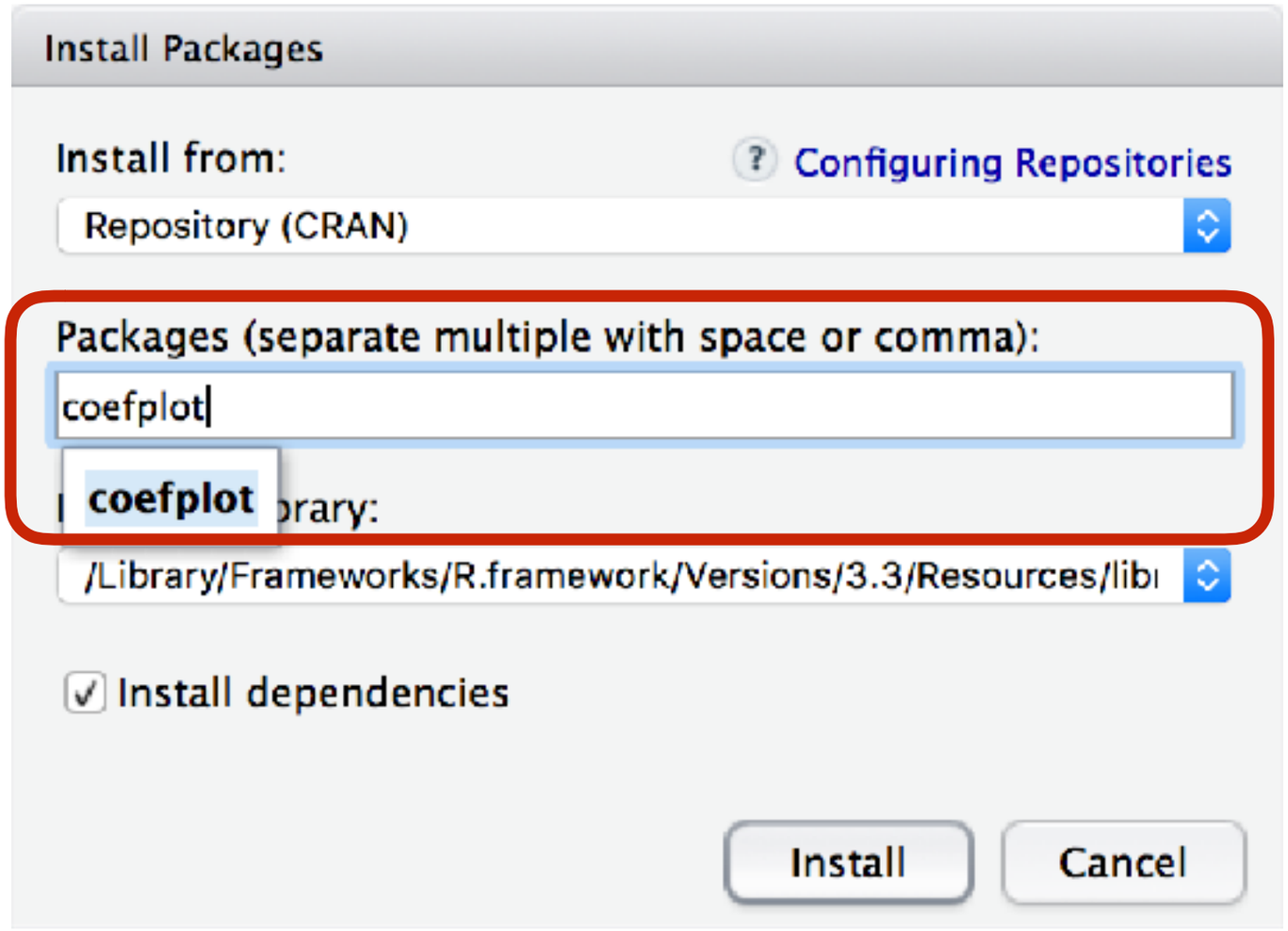
Installing package

R studio
R console
R command line

Install package on R studio



Install package on R studio



Install package on R console

```
>install.packages("coefplot")
>install.packages("coefplot",
                  dependencies = TRUE)
```

Uninstall package

```
>remove.packages("coefplot")
```

Loading package

```
>library("coefplot")
```

Unloading package

```
>detach("package:coefplot")
```

Clear the console in R Studio

```
>cat("\014")
>cat("\f")
```

Press Control + K

see demo in R

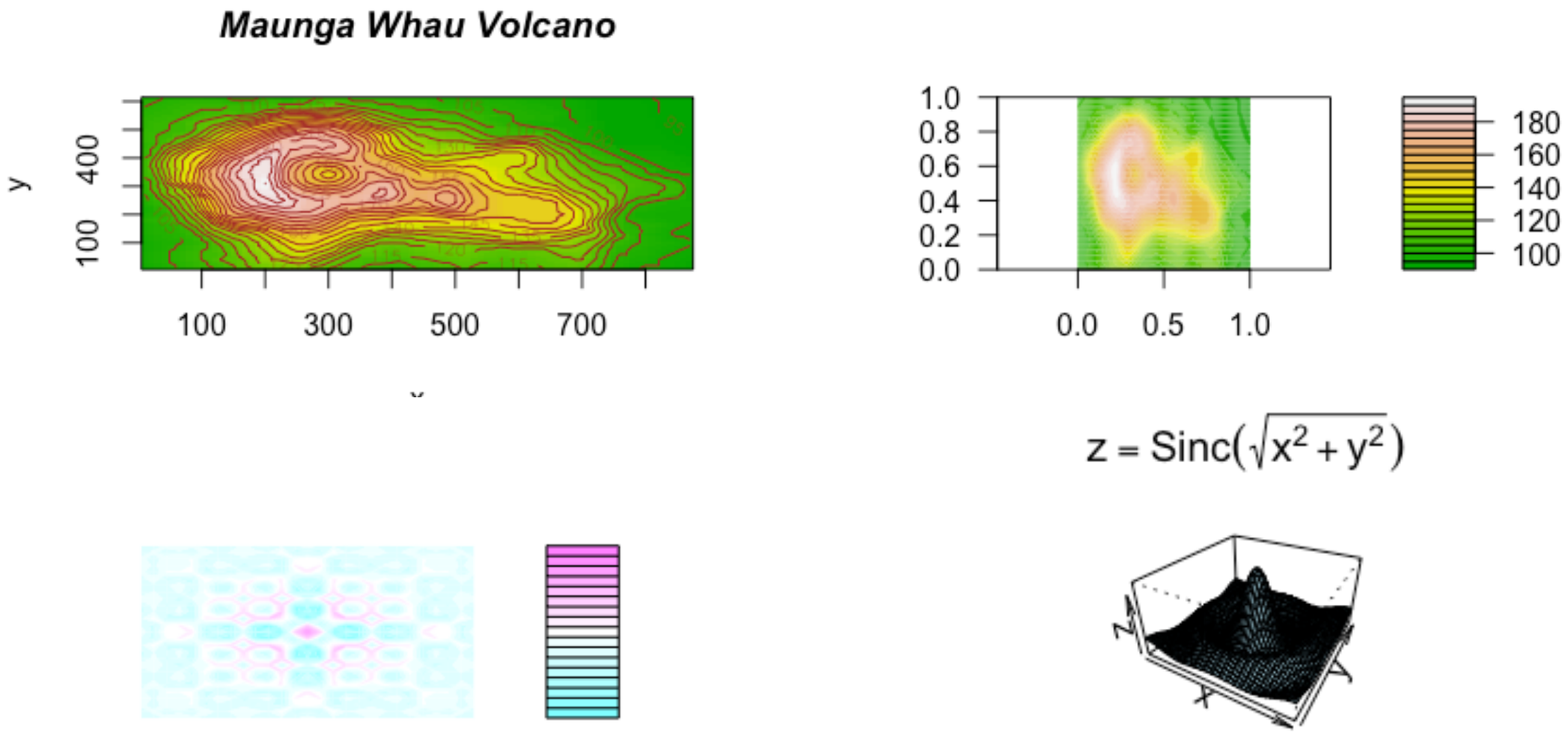
List of all Demo

>demo()

```
Demos in package 'base':

error.catching   More examples on catching and
                 handling errors
is.things        Explore some properties of R
                 objects and is.FOO() functions.
                 Not for newbies!
recursion        Using recursion for adaptive
                 integration
scoping          An illustration of lexical
                 scoping.

Demos in package 'graphics':

Hershey          Tables of the characters in the
                 Hershey vector fonts
Japanese         Tables of the Japanese characters
                 in the Hershey vector fonts
graphics         A show of some of R's graphics
                 capabilities
image            The image-like graphics builtins
                 of R
persp            Extended persp() examples
plotmath         Examples of the use of
                 mathematics annotation
```

Image demo

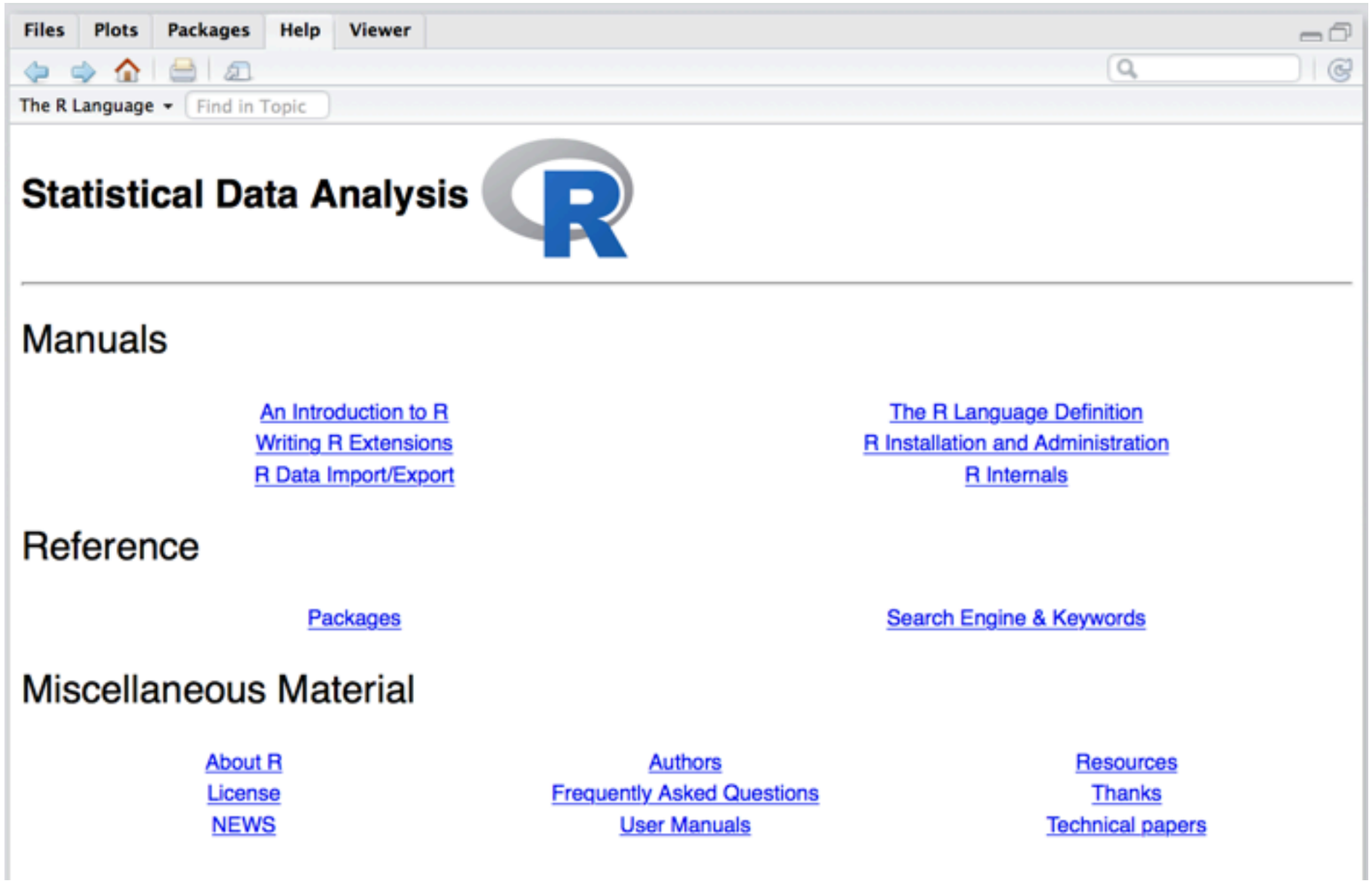
>demo(image)



$$z = \mathrm{Sinc}(\sqrt{x^2 + y^2})$$

Help function

>help.start()



Help function

Function	Action
help(“foo”) or ?foo	Help of function foo
help.search(“foo”) or ??foo	Search the help function for foo
example(“foo”)	See example usage of foo
data()	List all example datasets of loaded packages

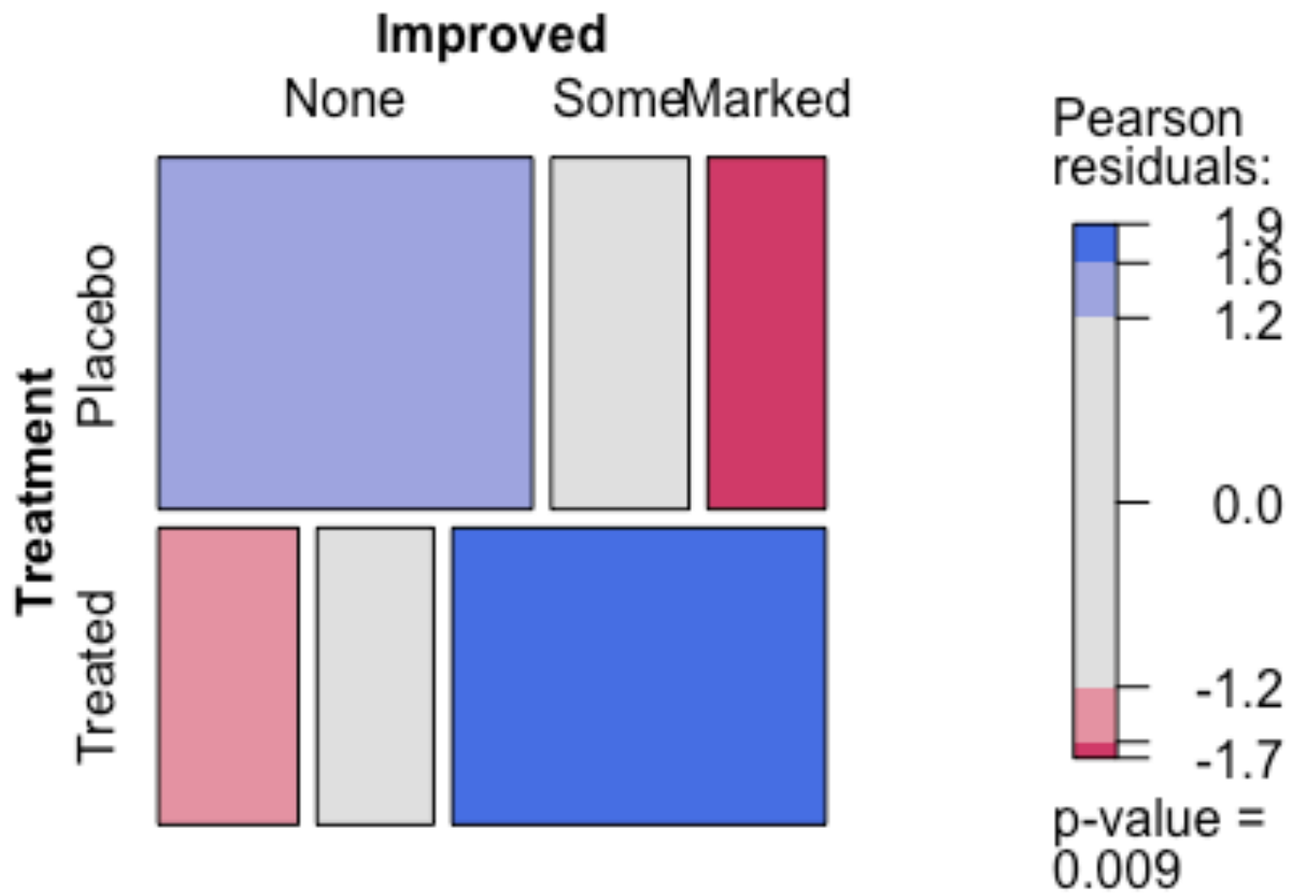
Save to file

Function	Output
bmp(“filename”)	BMP file
jpeg(“filename”)	JPEG file
pdf(“filename”)	PDF file
png(“filename”)	PNG file
svg(“filename”)	SVG file
postscript(“filename)	PostScript file

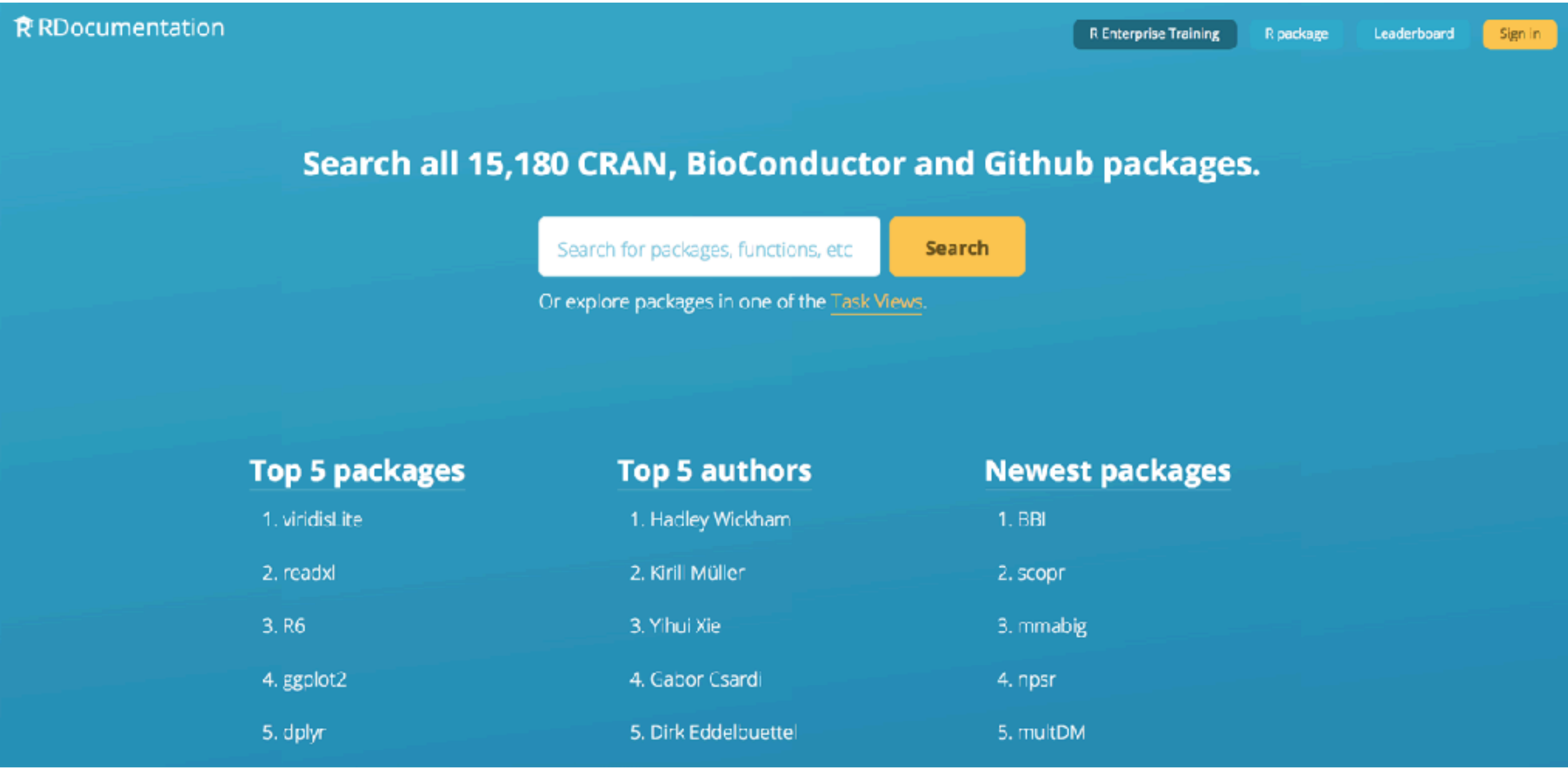
Try to write code

```
help.start()
install.packages("vcd")
help(package="vcd")
library(vcd)
help(Arthritis)
Arthritis
example(Arthritis)
q()
```

Try to write code



R Documentation



https://www.rdocumentation.org/

Working with Large Dataset

R holds objects in memory

Size of dataset ?
Statistical methods that will apply ?
Efficient Programming ?

R in BigData

Package	Description
bigmemory	Support the creation/storage/access/ mulnipulation of massive metrics
ff	Provide data structures that store in disk
filehash	Simple key-value database
ROracle, RMySQL, RPostgreSQL	Access to RDBMS

R in BigData

https://spark.apache.org/docs/latest/sparkr.html

R in BigData

R Server for Azure HDInsight

Microsoft

Familiarity of R algorithms

+

Scalability of Hadoop + Spark

=

More Accurate Predictions

https://azure.microsoft.com/en-us/services/hdinsight/r-server/

Basic of **R**

Basic of R

Calculation
Data manipulation
Scientific computation

Variable assignment

```r
first = 1
second <- 2
assign("third", 3)
4 -> fourth

cat(first, second, third, fourth)

#Remove variable
rm(second)
```

Math in R

```
2 + 2
2 - 2
2 * 2
2 %% 2
2 %/% 2
2 / 2
2 ** 2
2 ** .5
2 ** -1
```

Few more complicate !!

```
abs(-2)
pi
round(pi,digits = 2)
sign(-2)
log(2)
log10(2)
cos(pi)
```

Logical table and testing

```
TRUE & TRUE
TRUE | FALSE
xor(TRUE,FALSE)
! FALSE
```

```
1 & 1
1 & 0
!0
```

Data types

Numeric
Character (string)
Date (time-based)
Logical (TRUE/FALSE)

Data types

```
class(FALSE)
class(pi)
class("Look at me")
class(as.Date("2018-08-09"))
class(factor(c('undergraduate','graduate')))
```

Numeric

By default, R store everything as double 64-bit floating point

```
#Force to integer
number <- 5L

class(number)
is.integer(number)
is.numeric(number)
```

Boolean

Logical values act like numeric

```
TRUE + TRUE
2 & 1
TRUE * TRUE
2 & -1
```

Boolean

Try to use in if-else statement !!

```
if (2017)
    print('This is evaluated as a boolean')
```

Character

Like character handling in UNIX !!

```
my.char <- paste("Hi", "guy", "I'm", "a", "string")
my.char <- paste0("Hi", "guy", "I'm", "a", "string")
```

Character

R is **not a zero-indexed** language !!

```
my.char <- paste("Hi", "guy")
substr(my.char,1,2)
substr(my.char,1,2) <- "OH"
strsplit(my.char, ' ')
gsub('.', 'X', my.char)
```

Date time

R stores datetime as a number of day since the epoch (1 Jan 1970)

```
my.date <- as.Date("2017-08-09")
my.date + 7
weekdays(my.date + 7)
my.date - 365
weekdays(my.date - 365)
```

Testing and change data type

```r
# Testing type
is.character(my.character)
is.numeric(my.character)

# Change type
as.character(9)
as.numeric(my.character)
```

Function in R

Try to break code in a small part which become easy to maintain and understand

Function in R

```r
# Function
pow <- function(x, y) {
  result <- x^y
}
a = pow(10, 2)

# Named arguments
a = pow(x=10, y=3)

# Default values for arguments
pow <- function(x, y = 2) {
  result <- x^y
}
a = pow(10)
```

Return value from function

```r
check <- function(x) {
  if(x>0) {
    result <- "Positive"
  } else if(x<0) {
    result <- "Negative"
  } else {
    result <- "Zero"
  }
  return(result)
}
```

Return value without return()

```
check <- function(x) {
  if(x>0) {
    result <- "Positive"
  } else if(x<0) {
    result <- "Negative"
  } else {
    result <- "Zero"
  }
  result
}
```

Multiple return from function

```r
multi <- function() {
  my_list <- list("id" = 1, "name" = "Somkiat", "age"= 30)
  return(my_list)
}

a = multi()
a$id
a$name
a$age
```

Workshop :: Easy calculator

Requirement

2 Inputs from command line
Choose a operation from common line
Operations => Add, Minus, Multiply, Divide

Create calculator.R

Read Input from command line ?

```
print("Choose operation")
print("1. Add")
print("2. Minus")
print("3. Multiply")
print("4. Divide")
```

```
selected <- as.integer(readline(prompt = "Choose [1/2/3/4]: "))
first <- as.integer1(readline(prompt = "Fill in first number: "))
second <- as.integer(readline(prompt = "Fill in second number: "))
```

Create calculator.R

Try to write functions by yourself

```
print("Choose operation")
print("1. Add")
print("2. Minus")
print("3. Multiply")
print("4. Divide")
```

```
selected <- as.integer(readline(prompt = "Choose [1/2/3/4]: "))
first <- as.integer1(readline(prompt = "Fill in first number: "))
second <- as.integer(readline(prompt = "Fill in second number: "))
```

Create calculator.R

Introduce to switch() function

```
add <- function(a, b) {
  return(a+b)
}
```

```
operator <- switch(selected, "+", "-", "*", "/")
result <- switch(selected, add(first, second))

print(paste(first, operator, second, "=", result))
```

Test-Driven Development (TDD) with R

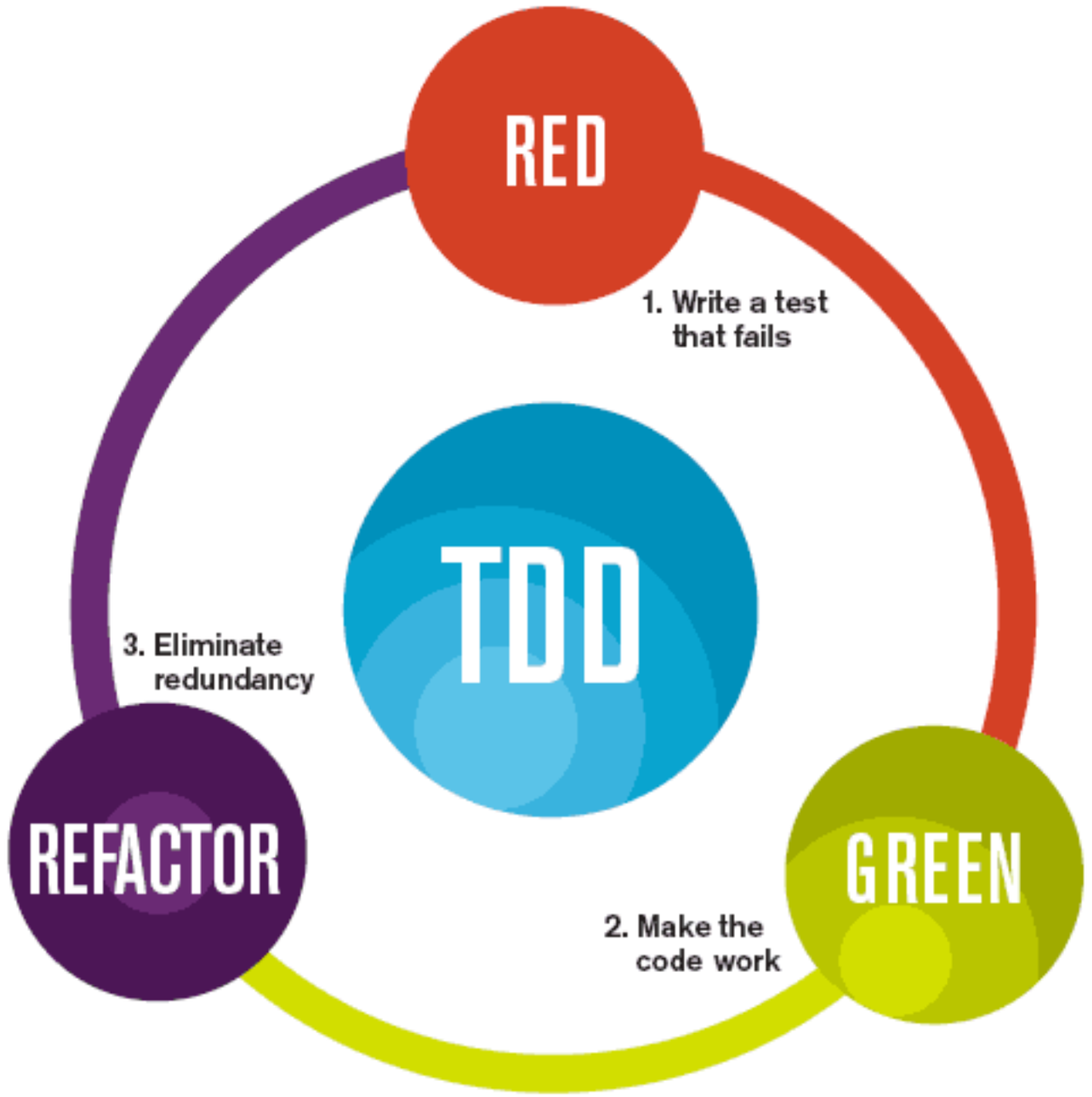
Real Situation

RStudio has a lot of debugging capabilities
Production code can get messy quickly
The biggest code == The bigger problem

Unit testing

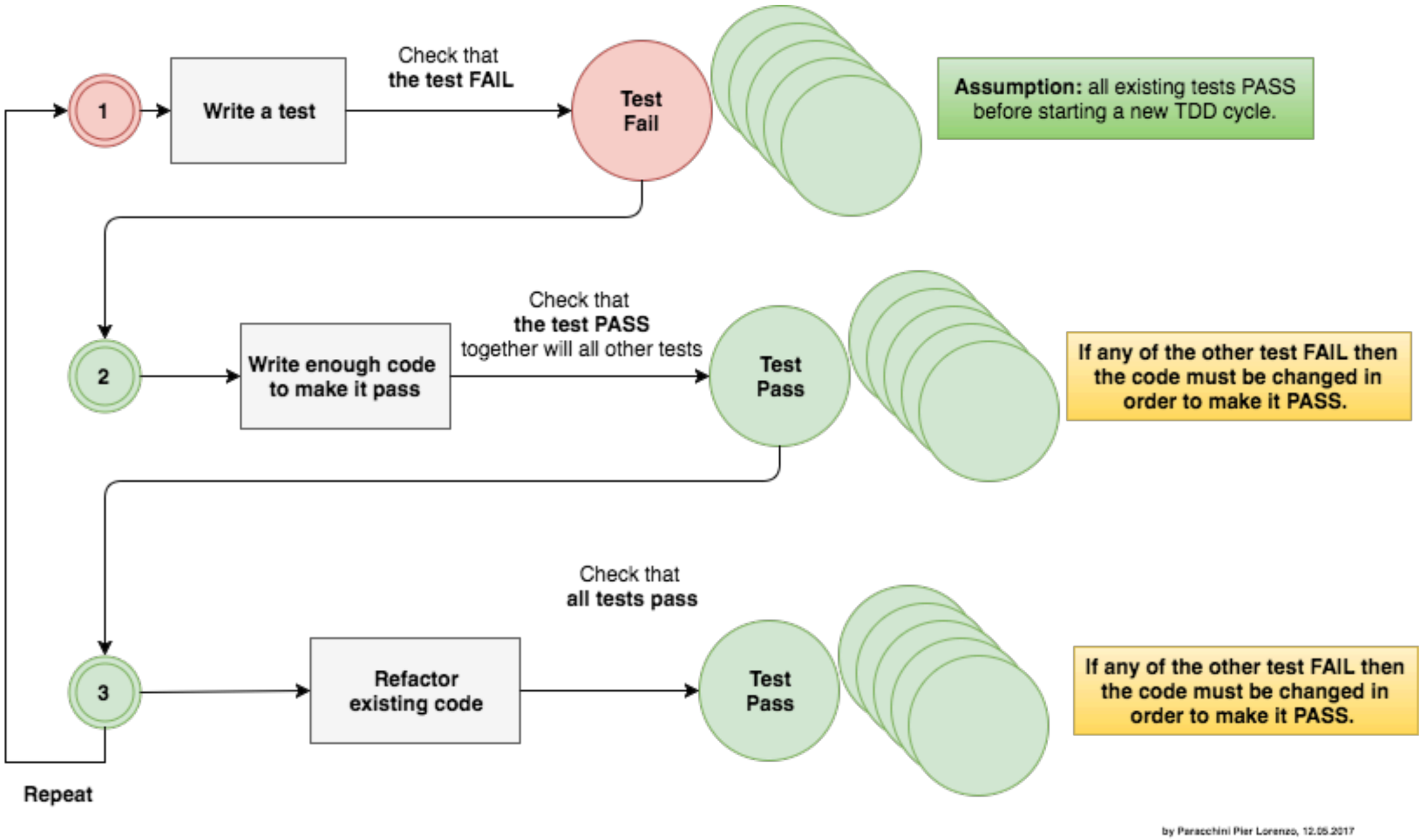
Low level tests of your code functionality
Written by developer
Defense against bugs in the code

Test-Driven Development (TDD)



The mantra of Test-Driven Development (TDD) is “red, green, refactor.”

TDD workflow



https://pparacch.github.io/2017/05/18/test_driven_development_in_r.html

Write Unit Test in R

Using **testthat** package

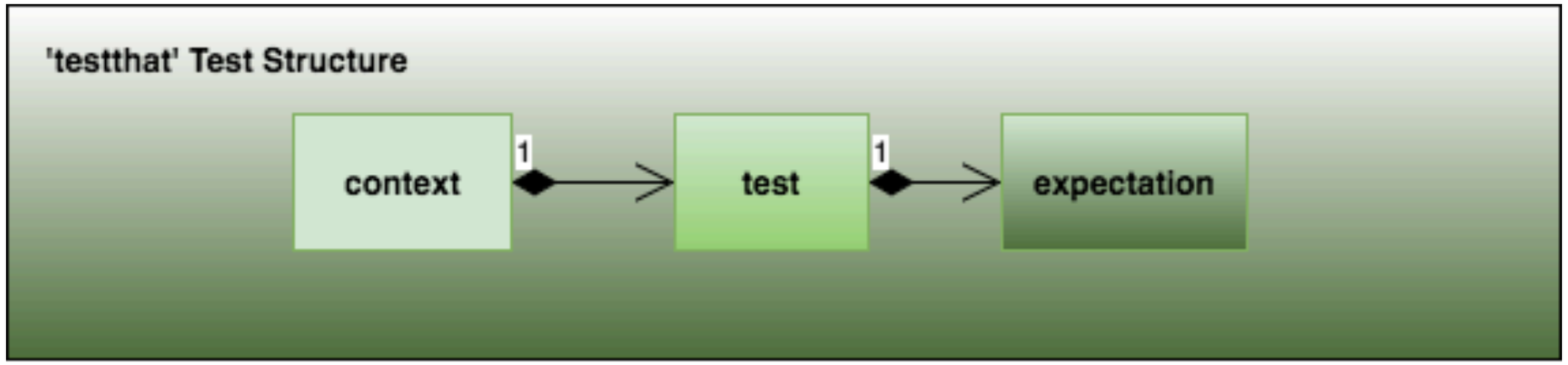
>install_packages("testthat")

"I wrote testthat because i discovered i spending to much time recreating bugs that i had previously fixed"

- Hadley Wickham -

https://cran.r-project.org/web/packages/testthat/index.html

Test Structure




```
context("testing context")
```

```
test_that("passing .... then an error is thrown"), {
    expect_error(object = function_under_test(arg1))
    expect_error(object = function_under_test(arg2))
}
```

```
test_that("passing .... then no error is thrown"), {
    expect_match(object = function_under_test(arg3), regexp = "...")
}
```

Project structure

```
.
├── runTest.R
├── src
│   └── hello.R
└── tests
    └── testHello.R
```

1. Create tests/testHello.R

```
context("TDD with R")
  test_that("Hello World", {
    expect_equal("Hello somkiat", say_hi("somkiat"))
  })
```

2. Create src/hello.R

```
say_hi <- function(name){
  return("TODO")
}
```

3. Create runTest.R

```
library('testthat')
source('./src/hello.R')
test_dir('./tests', reporter = 'Summary')
```

4. Run first test

$Rscript runTest.R

```
TDD with R: 1

══ Failed ══════════════════════════════════════════════════════════
── 1. Failure: Hello World (@testHello.R#3)  ──
"Hello somkiat" not equal to say_hi("somkiat").
1/1 mismatches
x[1]: "Hello somkiat"
y[1]: "TODO"

══ DONE ════════════════════════════════════════════════════════════
```

5. Modify src/hello.R

```r
say_hi <- function(name){
  return(sprintf("Hello %s", name))
}
```

6. Run test again

$Rscript runTest.R

```
TDD with R: .

══ DONE ═══════════════════════════════
You are a coding rockstar!
```

Try to practice with Easy Calculator

Flow controls

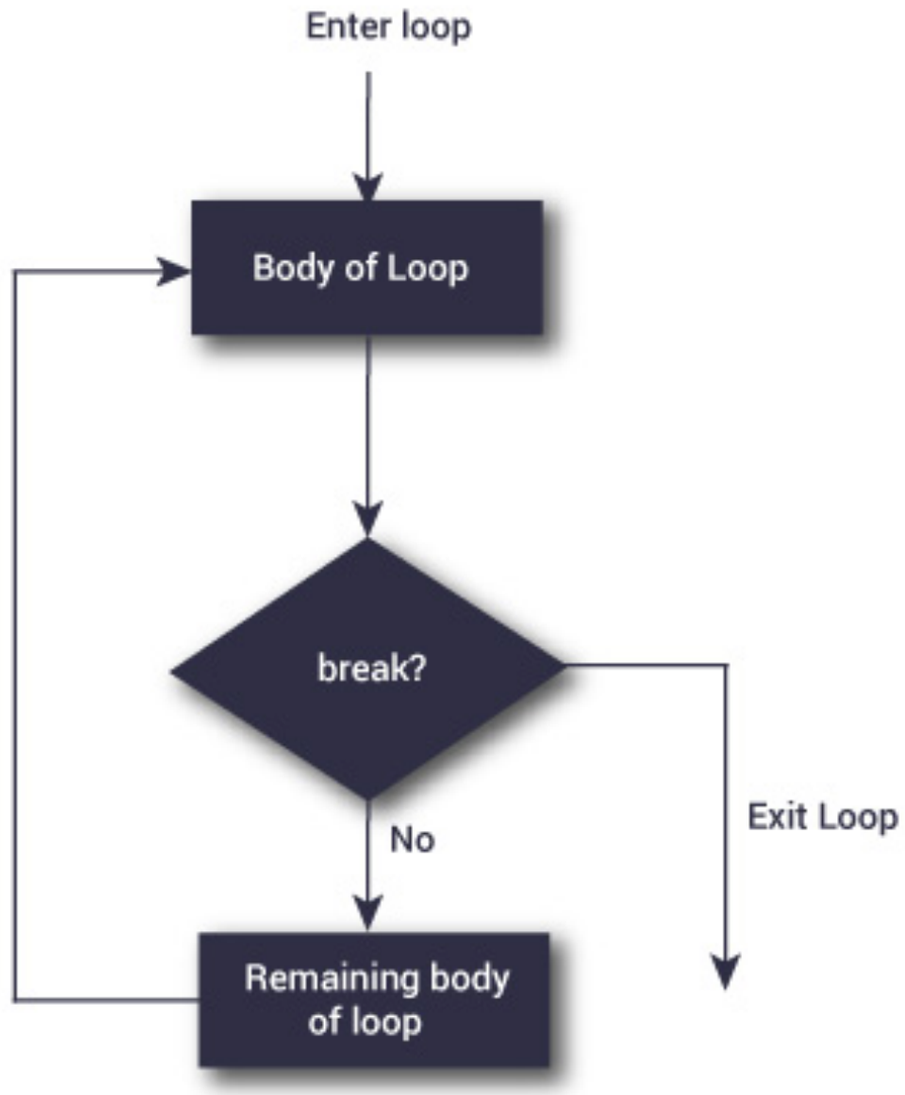
Flow controls

if ... else if ... else
ifelse(expresstion, true, false)
for loop
while loop
repeat loop

For loop

```r
numbers <- c(1, 2, 3, 4, 5)
for(number in numbers) {
  print(number)
}
```

Repeat loop


Enter loop
Body of Loop
break?
No
Exit Loop
Remaining body of loop

Repeat loop

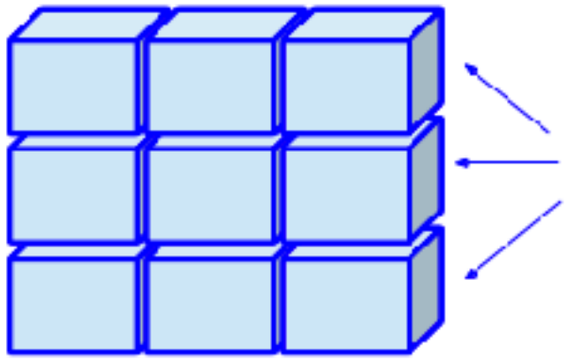
```
i <- 1
repeat {
   if(numbers[i] > 4) {
      break
   }
   print(numbers[i])
   i <- i+1
}
```

Data structure

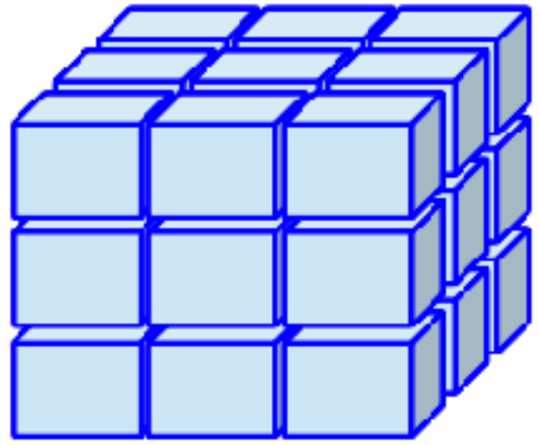
Data structure

Vector

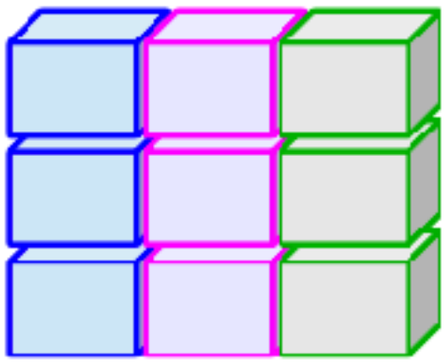
Matrix



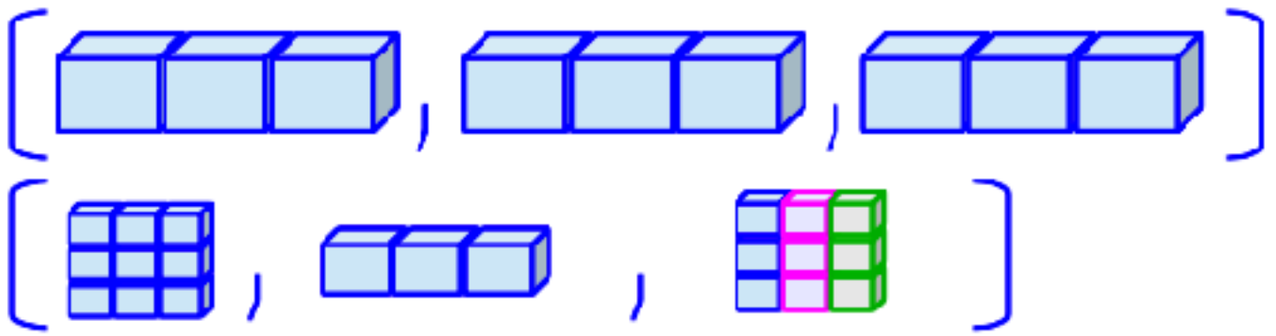
Array



Data Frame
(Table)



Lists



Vector

Collection of elements, all the same type

```
# Create vector
datas <- c(1, 2, 3, 4, 5)
datas
```

Vector

Create sequence of number

```
# Create vector
datas <- 1:5
datas
```

Matrices

Special case of Vector
Matrices have a dimension attribute

```
my.mat <- matrix(nrow = 2, ncol = 4)
my.mat <- matrix(1:8, nrow = 2, ncol = 4)
```

Matrices

Special case of Vector
Matrices have a dimension attribute

```
my.vec <- 1:8
dim(my.vec) <- c(2, 4)
my.vec
```

Matrices

Special case of Vector

```
vec1 <- 1:4
vec2 <- sample(1:100, 4, replace = FALSE)
vec3 <- rnorm(4, mean = 0, sd = 1)

column.mat <- cbind(vec1, vec2, vec3)
```

Array

Similar matrics but can have more than 2 dimension

```
d1 <- c('a1', 'a2')
d2 <- c('b1', 'b2', 'b3')
d3 <- c('c1', 'c2', 'c3')

e1 <- array(data=1:18, c(2, 3, 3))
e2 <- array(data=1:18, c(2, 3, 3), dimnames = list(d1, d2, d3 ))
```

DataFrame

Different columns can contain different mode of data

```
my.data <- data.frame(
  column1 = c(1,2,3),
  column2 = c('one','two','three'),
  column3 = c(TRUE,TRUE,FALSE))
```

Data

patientId	age	status	diabetes
1	25	Poor	Type1
2	35	Improved	Type2
3	28	Excellent	Type1
4	52	Poor	Type1
5	38	Poor	Type2

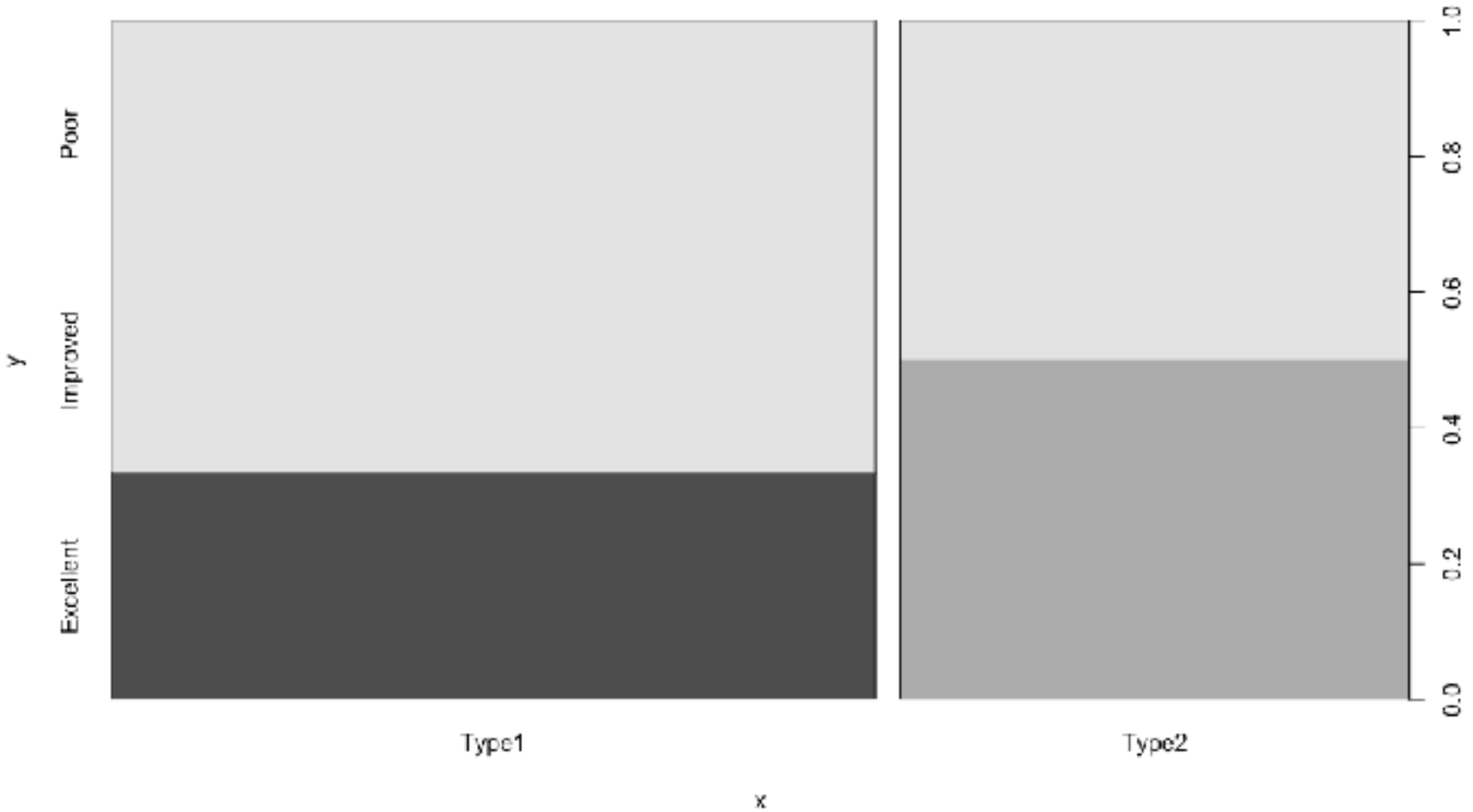
Use DataFrame

```
patientId <- c(1, 2, 3, 4, 5)
age <- c(25, 35, 28, 52, 38)
status <- c('Poor', 'Improved', 'Excellent', 'Poor', 'Poor')
diabetes <- c("Type1", "Type2", "Type1", "Type1", “Type2")

data <- data.frame(patientId, age, status, diabetes)
```

```
data[1:1]
data[1:2]
data['age']
data[c('patientId','age')]
data$age
data$patient
```

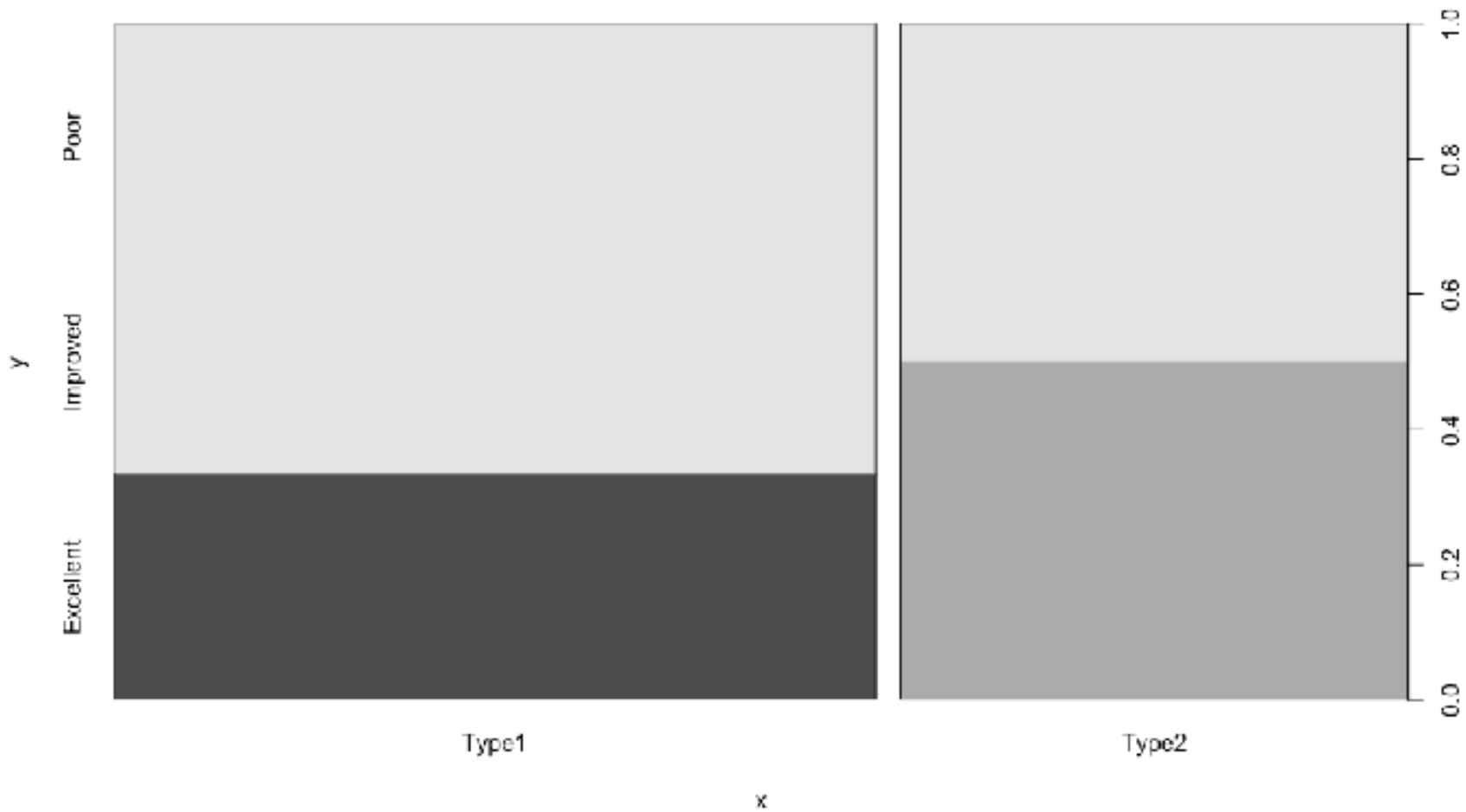
Use DataFrame

```
table(data$diabetes, data$status)
plot(data$diabetes, data$status)
str(data)
summary(data)
```



Use with() function

```
with(data, {
  plot(diabetes, status)
})
```



Factor

R stores factors internally as integer
Use the character strings as labels

```
diabetes <- c("Type1", "Type2", "Type1", "Type1")
diabetes <- diabetes <- factor(diabetes)
```

```
status <- c("Poor", "Improved", "Excellent", "Poor")
status <- factor(status, order=TRUE,
                 levels=c("Poor", "Improved", "Excellent"))
```

Factor

Use to create value labels for categorical variables

```
gender <- c(1, 1, 2, 2)

patientdata$gender <- factor(patientdata$gender,
                             levels = c(1,2),
                             labels = c("male", "female"))
```

List

Collection of elements, are not same type

```
my.list = list(1, 'two', 3)
my.list
```

```
class(my.list)
my.list[1]
my.list[[1]]

str(my.list)
```

List

Most complex of the R data types

```r
x <- "Somkiat"
y <- c(1, 2, 3, 4)
z <- matrix(1:10, nrow = 2)

my_list <- list(title = x, id = y, z)
```

```r
my_list[[1]]
my_list[[2]]
my_list[[3]]

my_list[["title"]]
my_list[["id"]]

my_list$title
my_list$id
```

Note for programmer

The period (.) has no special significance
Not provide multiline or block comment(#)
Indices in R start at 1
Variables can’t be declared

Note for programmer

Assign value to nonexistent element of vector/matrix/list expands that structure to the new value

```
x <- c(1, 2, 3, 4)
x[10] <- 10
x

[1]  1  2  3  4 NA NA NA NA NA 10

x <- x[1:3] # Back to three elements
```

Write some code with R

Data

Age (month)	Weight (kg.)
1	4.4
3	5.3
5	7.2
2	5.2
11	8.5
9	7.1
12	10.5
3	6.2
6	6.9

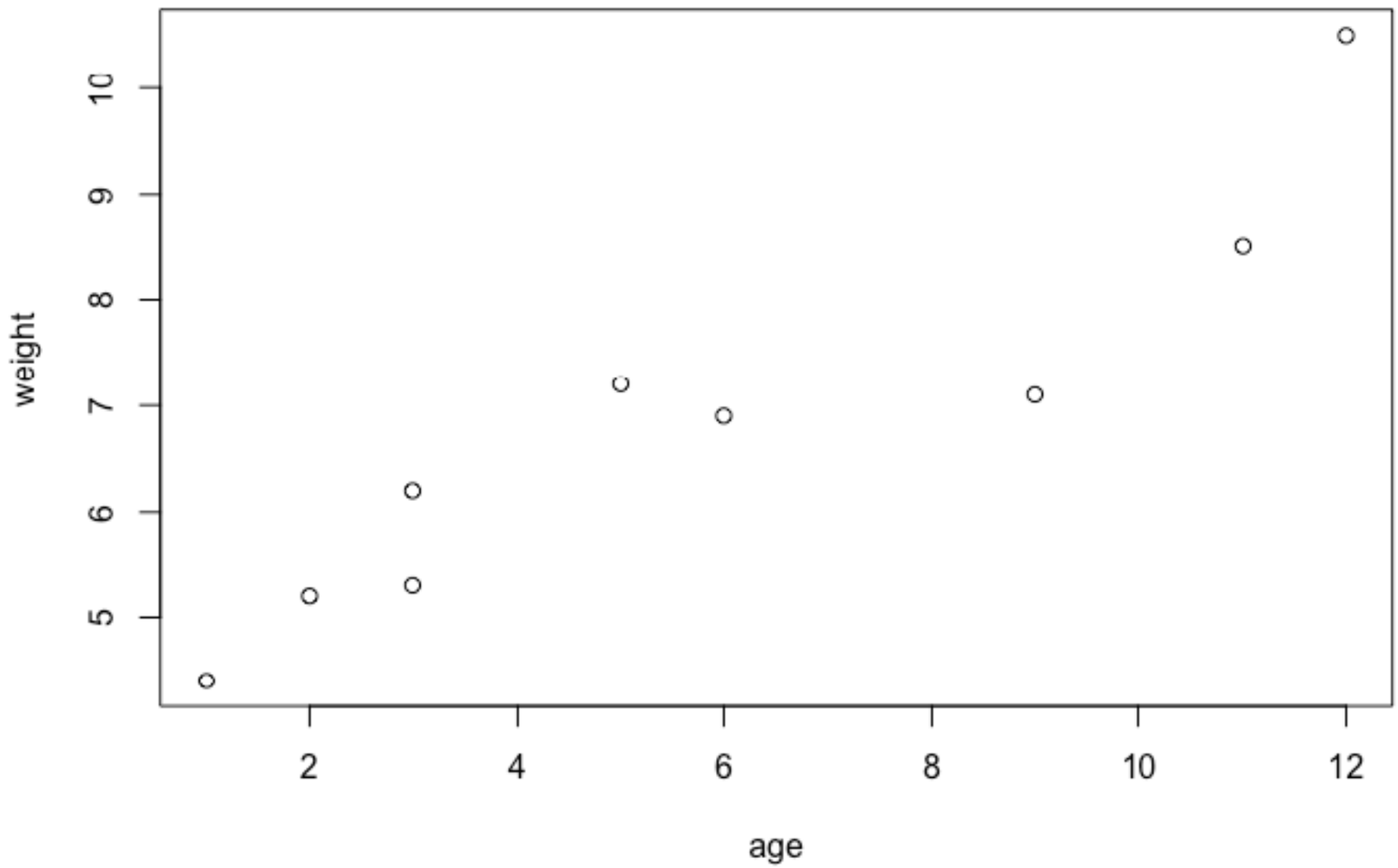
Write R Code

Create 2 lists => keep age and weight

```
age <- c(1,3,5,2,11,9,12,3,6)
weight <- c(4.4,5.3,7.2,5.2,8.5,7.3,6.0,10.4,10.2,6.1)

sd(weight)
mean(weight)
cor(age, weight)
plot(age, weight)
q()
```

Plot data

plot(age, weight)



Reading data

- Flat Files
- Excel Files
- Statistical Software
- Databases
- Data from the Web

https://www.r-bloggers.com/how-to-learn-r-2/

Reading data

1. From keyboard
2. **From text file (delimited text)**
3. From connections
4. From Excel (XLConnect, Readxl)
5. From XML/JSON (XML, rjson)
6. From Web

https://www.datacamp.com/community/tutorials/r-data-import-tutorial

Reading data (more)

SPSS, SAS, Stada, NetCDF, HDF5

RDBMS => Oracle, MSSQL, MySQL etc.

Read data from text file

Read data from text file

Using read.table() function

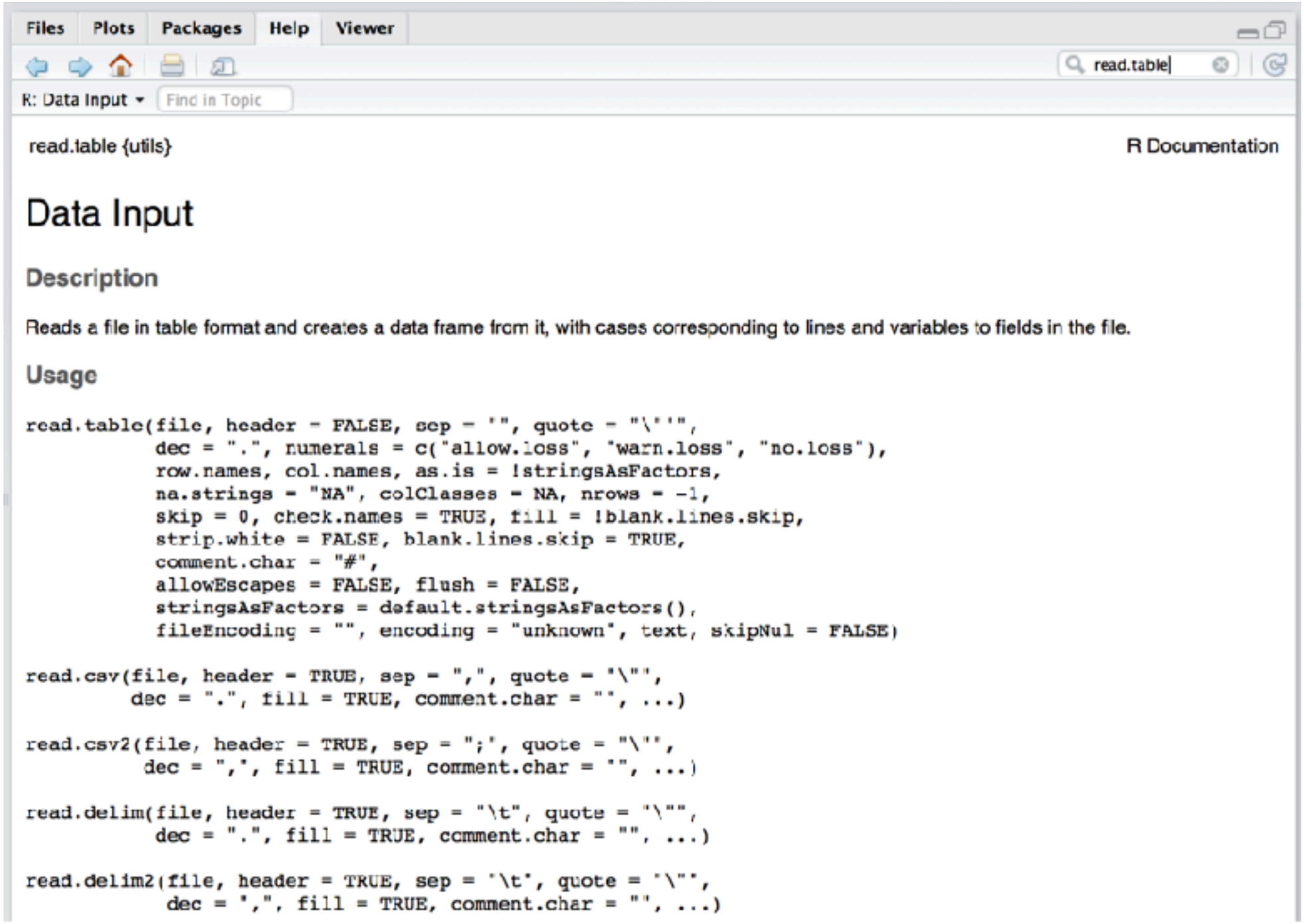
Read a file in table format and save to data frame

dataframe <- read.table(file, options)

read.table() options

Options	Description
header	Variable names in first line or not
sep	Delimiter separating data values
row.names	Variables to represent row identifiers
col.names	Use when header=FALSE
na.strings	Vector indicating missing value codes

See more in help()



Read data

```
StudentID,First name,Last name,Math,Science
011,Bob,Smith,90,80
012,Jane,Weary,75,
010,Dan,"Thornton, III",65,75
040,Mary,"O'Leary",90,95
```

```r
datas <- read.table("data01.csv", header=TRUE,
                    row.names="StudentID", sep=",")
```

Read data

```
datas <- read.table("data01.csv", header=TRUE,
                    row.names="StudentID", sep=",")
```

```
> str(datas)
'data.frame':   4 obs. of  4 variables:
 $ First.name: Factor w/ 4 levels "Bob","Dan","Jane",..: 1 3 2 4
 $ Last.name : Factor w/ 4 levels "O'Leary","Smith",..: 2 4 3 1
 $ Math      : int  90 75 65 90
 $ Science   : int  80 NA 75 95
```

See in result

```
datas <- read.table("data01.csv", header=TRUE,
                    row.names="StudentID", sep=",")
```

```
> str(datas)
'data.frame':   4 obs. of  4 variables:
 $ First.name: Factor w/ 4 levels "Bob","Dan","Jane",..: 1 3 2 4
 $ Last.name : Factor w/ 4 levels "O'Leary","Smith",..: 2 4 3 1
 $ Math      : int  90 75 65 90
 $ Science   : int  80 NA 75 95
```

StudentID column is the row name, not has a label

See in result

```
datas <- read.table("data01.csv", header=TRUE,
                    row.names="StudentID", sep=",")
```

```
> str(datas)
'data.frame':   4 obs. of  4 variables:
$ First.name: Factor w/ 4 levels "Bob","Dan","Jane",..: 1 3 2 4
$ Last.name : Factor w/ 4 levels "O'Leary","Smith",..: 2 4 3 1
$ Math      : int  90 75 65 90
$ Science   : int  80 NA 75 95
```

Renamed of variables to R convention

See in result

```
datas <- read.table("data01.csv", header=TRUE,
                    row.names="StudentID", sep=",")
```

```
> str(datas)
'data.frame':   4 obs. of  4 variables:
 $ First.name: Factor w/ 4 levels "Bob","Dan","Jane",..: 1 3 2 4
 $ Last.name : Factor w/ 4 levels "O'Leary","Smith",..: 2 4 3 1
 $ Math      : int  90 75 65 90
 $ Science   : int  80 NA 75 95
```

See missing value

See in result

```
datas <- read.table("data01.csv", header=TRUE,
                    row.names="StudentID", sep=",")
```

```
> str(datas)
'data.frame':   4 obs. of  4 variables:
$ First.name: Factor w/ 4 levels "Bob","Dan","Jane",..: 1 3 2 4
$ Last.name : Factor w/ 4 levels "O'Leary","Smith",..: 2 4 3 1
$ Math      : int  90 75 65 90
$ Science   : int  80 NA 75 95
```

First and Last name are converted to factors

By default, read.table() convert character variable to factors

Change option :: disable factor

```
datas <- read.table("data01.csv", header=TRUE,
                    row.names="StudentID", sep=",",
                    stringsAsFactors = FALSE)
```

```
> str(datas)
'data.frame':   4 obs. of  4 variables:
 $ First.name: chr  "Bob" "Jane" "Dan" "Mary"
 $ Last.name : chr  "Smith" "Weary" "Thornton, III" "O'Leary"
 $ Math      : int  90 75 65 90
 $ Science   : int  80 NA 75 95
```

Change option :: change class

```
datas <- read.table("data01.csv", header=TRUE,
                    row.names="StudentID", sep=",",
                    stringsAsFactors = FALSE,
                    colClasses = c("character", "character",
"character", "numeric", "numeric"))
```

```
> str(datas)
'data.frame':   4 obs. of  4 variables:
 $ First.name: chr  "Bob" "Jane" "Dan" "Mary"
 $ Last.name : chr  "Smith" "Weary" "Thornton, III" "O'Leary"
 $ Math      : num  90 75 65 90
 $ Science   : num  80 NA 75 95
```

Read data from Fixed column data

Read data

scores.txt

```
Phys / 00 /   1:    M  abadda
Math / 00 /   2:    F  bcdccb
Lang / 00 /   3:    F  abcdab
Chem / 00 /   4:    M  cdabaa
```

Read data from fixed column file

Using read.fwf() function

Fixed **W**ith **F**ormatted data

dataframe <- read.fwf(file, options)

See more in help()

Files | Plots | Packages | Help | Viewer

read.fwf

R: Read Fixed Width Format Files — Find in Topic

read.fwf {utils} — R Documentation

Read Fixed Width Format Files

Description

Read a table of fixed width formatted data into a data.frame.

Usage

```
read.fwf(file, widths, header = FALSE, sep = "\t",
         skip = 0, row.names, col.names, n = -1,
         buffersize = 2000, fileEncoding = "", ...)
```

Arguments

file	the name of the file which the data are to be read from. Alternatively, file can be a connection, which will be opened if necessary, and if so closed at the end of the function call.
widths	integer vector, giving the widths of the fixed-width fields (of one line), or list of integer vectors giving widths for multiline records.
header	a logical value indicating whether the file contains the names of the variables as its first line. If present, the names must be delimited by sep.
sep	character; the separator used internally; should be a character that does not occur in the file (except in the header).

Read data

scores.txt

```
Phys / 00 /   1:    M   abadda
Math / 00 /   2:    F   bcdccb
Lang / 00 /   3:    F   abcdab
Chem / 00 /   4:    M   cdabaa
```

7

Read data

scores.txt

```
Phys / 00 /   1:    M   abadda
Math / 00 /   2:    F   bcdccb
Lang / 00 /   3:    F   abcdab
Chem / 00 /   4:    M   cdabaa
```

Read data

scores.txt

```
Phys / 00 /   1:    M   abadda
Math / 00 /   2:    F   bcdccb
Lang / 00 /   3:    F   abcdab
Chem / 00 /   4:    M   cdabaa
```

1

Read data

scores.txt

```
Phys / 00 /   1:    M   abadda
Math / 00 /   2:    F   bcdccb
Lang / 00 /   3:    F   abcdab
Chem / 00 /   4:    M   cdabaa
```

2

Read data

scores.txt

```
Phys / 00 /   1:    M   abadda
Math / 00 /   2:    F   bcdccb
Lang / 00 /   3:    F   abcdab
Chem / 00 /   4:    M   cdabaa
```

111111

Read data

```
datas <-   read.fwf("scores.txt",
          widths= c(7,-14, 1, -2, 1, 1, 1, 1, 1, 1),
col.names=c("subject","sex","s1","s2","s3","s4","s5","s6"),
          strip.white=TRUE)
```

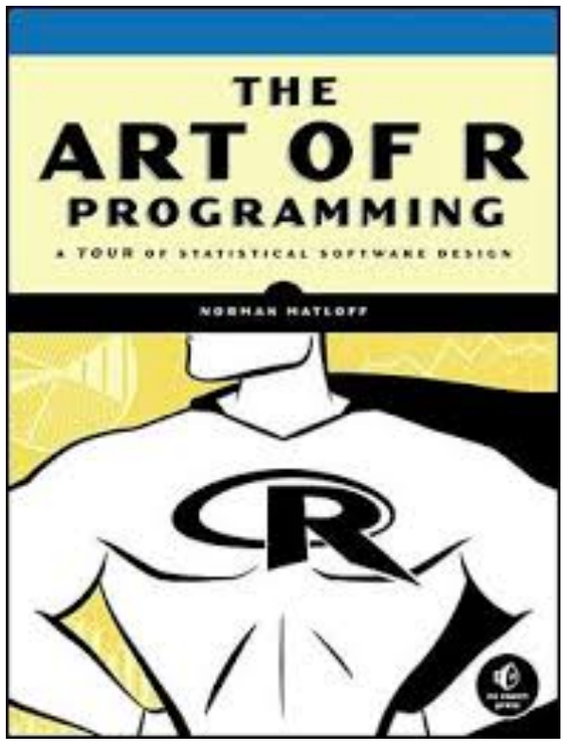
```
> datas
   subject sex s1 s2 s3 s4 s5 s6
1     Phys   M  a  b  a  d  d  a
2     Math   F  b  c  d  c  c  b
3     Lang   F  a  b  c  d  a  b
4     Chem   M  c  d  a  b  a  a
```

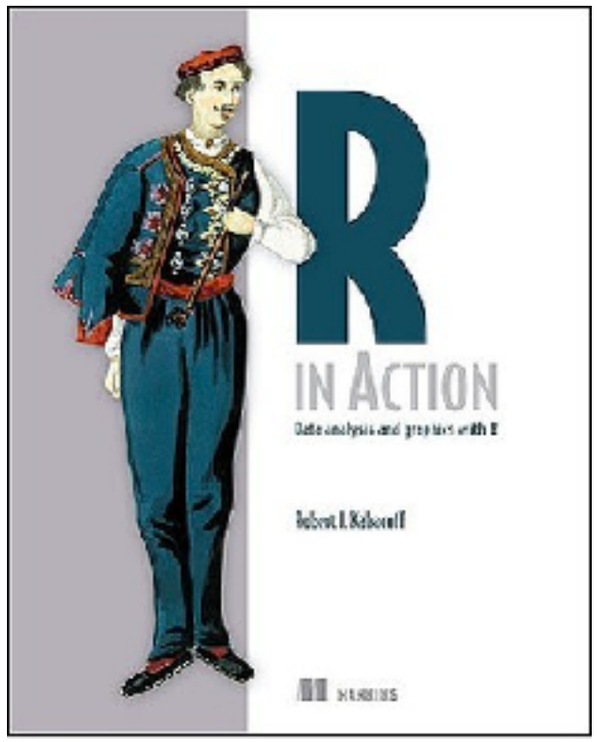
Useful function with dataset

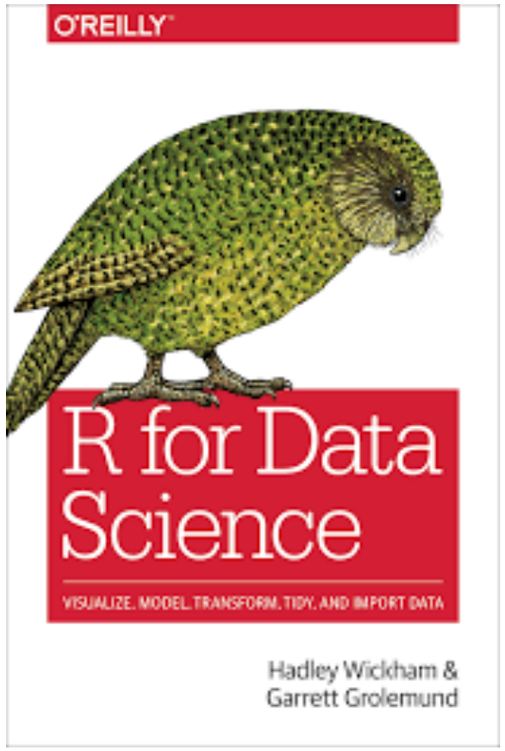
Function	Description
length(object)	Number of elements in an object
dim(object)	Dimension of an object
str(object)	Structure of an object
class(object)	Class of an object
mode(object)	How an object is stored
names(object)	Given the names of elements in an
c(object, object, …)	Combines objects into a vector
head(object)	List of first part of an object
tail(object)	List of last part of an object
rm(object, object, …)	Delete one or more objects

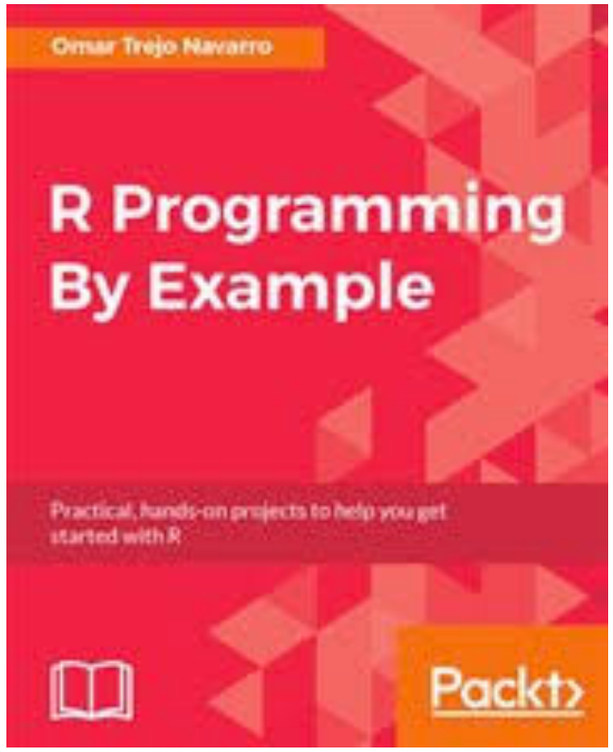
Statistical graphics

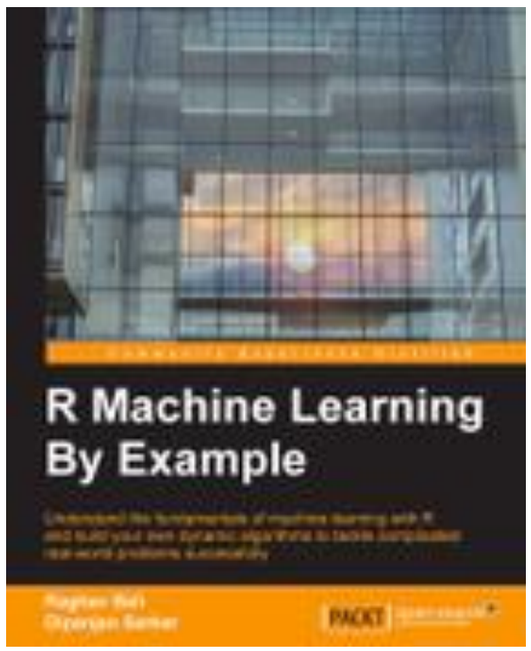
Resources


THE
ART OF R
PROGRAMMING
A TOUR OF STATISTICAL SOFTWARE DESIGN
NORMAN MATLOFF


R
IN ACTION


O'REILLY
R for Data Science
VISUALIZE, MODEL, TRANSFORM, TIDY, AND IMPORT DATA
Hadley Wickham &
Garrett Grolemund


Omar Trejo Navarro
R Programming
By Example
Practical, hands-on projects to help you get started with R
Packt


R Machine Learning
By Example
PACKT

Data manipulation

Workshop