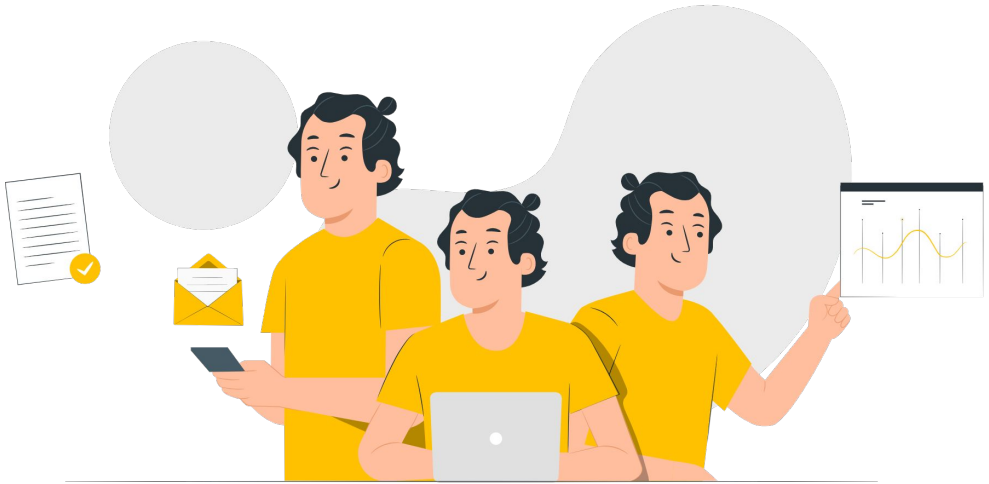
Programming Foundation

LIVE 04 - Data Science Bootcamp

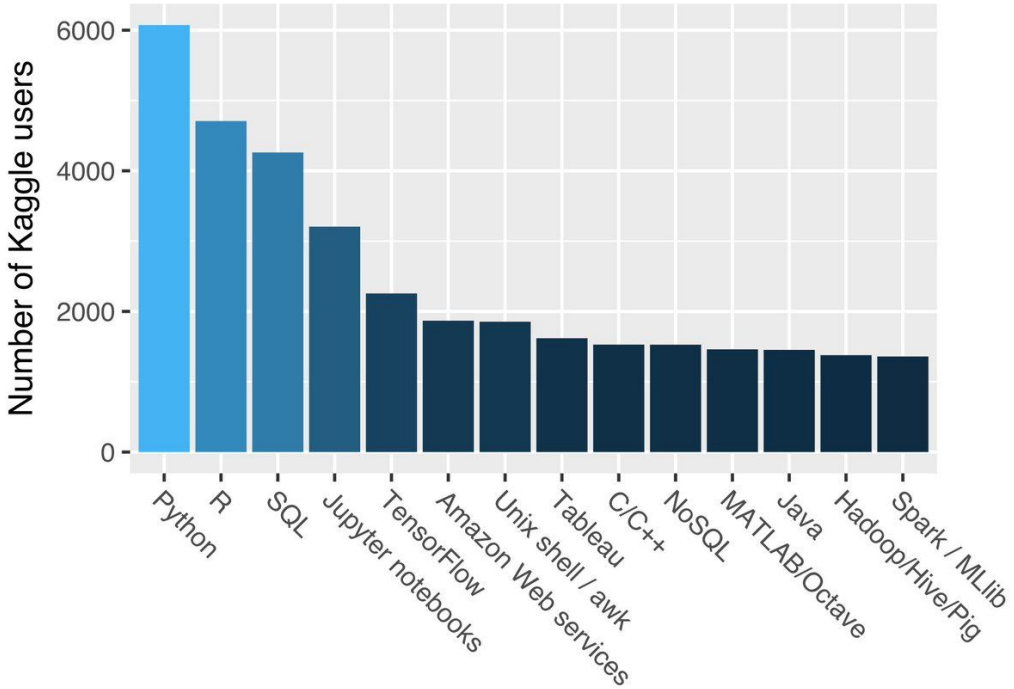
Programming foundation

1. Variables
2. Data types
3. Data structures
4. Control flow
5. Function

Language of choice: R



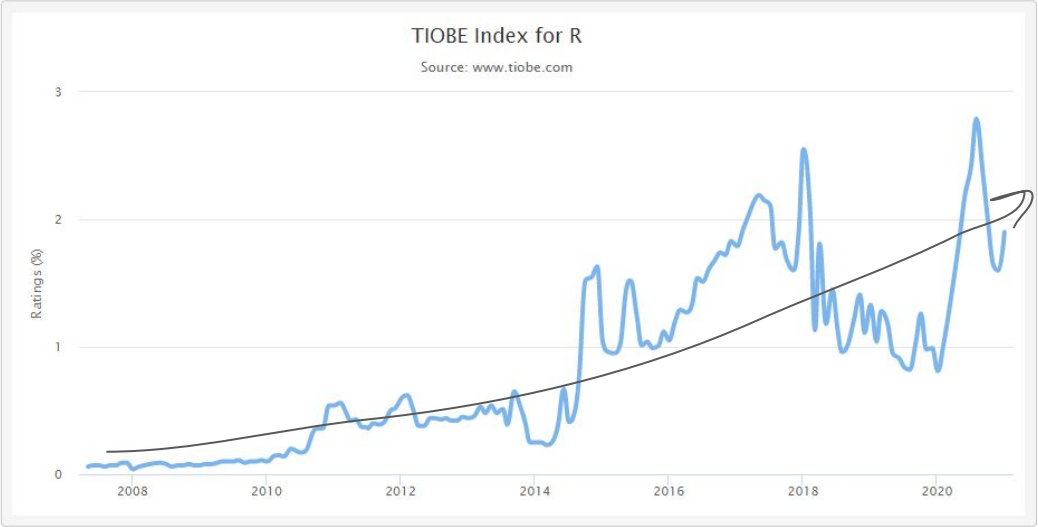
Data Science Tools/ Languages



The importance of R in data science ecosystem

Highest Position (since 2007): #8 in Aug 2020

Lowest Position (since 2007): #73 in Dec 2008



R is among top three language for data science

Will R help you get a new job?

Yes 3000 times!

Data Analyst

PwC Thailand · Bangkok, Bangkok City, Thailand

Posted 1 week ago · 1,165 views

Easy Apply Save

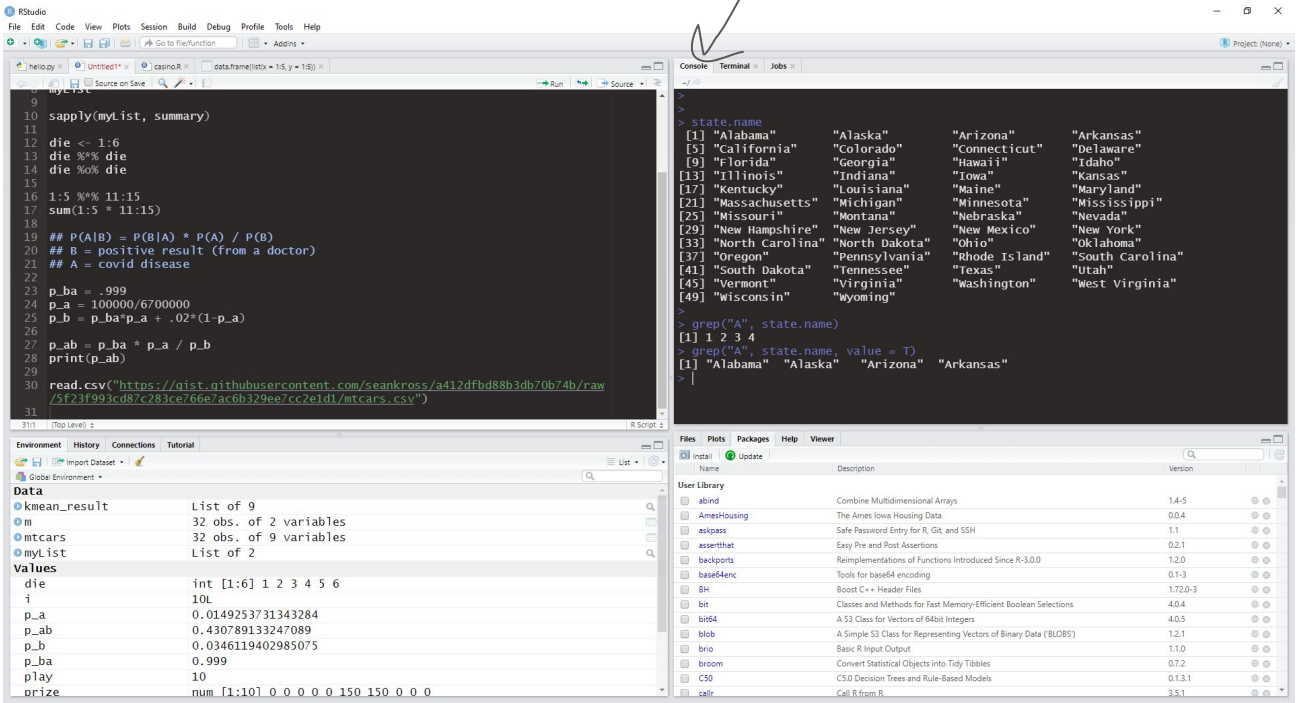
Qualifications

- Bachelor's or master's degree in Business Analytics, Computer Science, Engineering, Information Systems or Technologies, Statistics or other related disciplines that possess an analytical component.
- 1-3 years of experience in developing, analysing, and interpreting data analytics solutions using some of the following software:
- Analytical software (e.g. R, SAS)
- Data visualisation tools (e.g. Qlikview, PowerBI,)
- Relational database management tools (e.g. SQL)

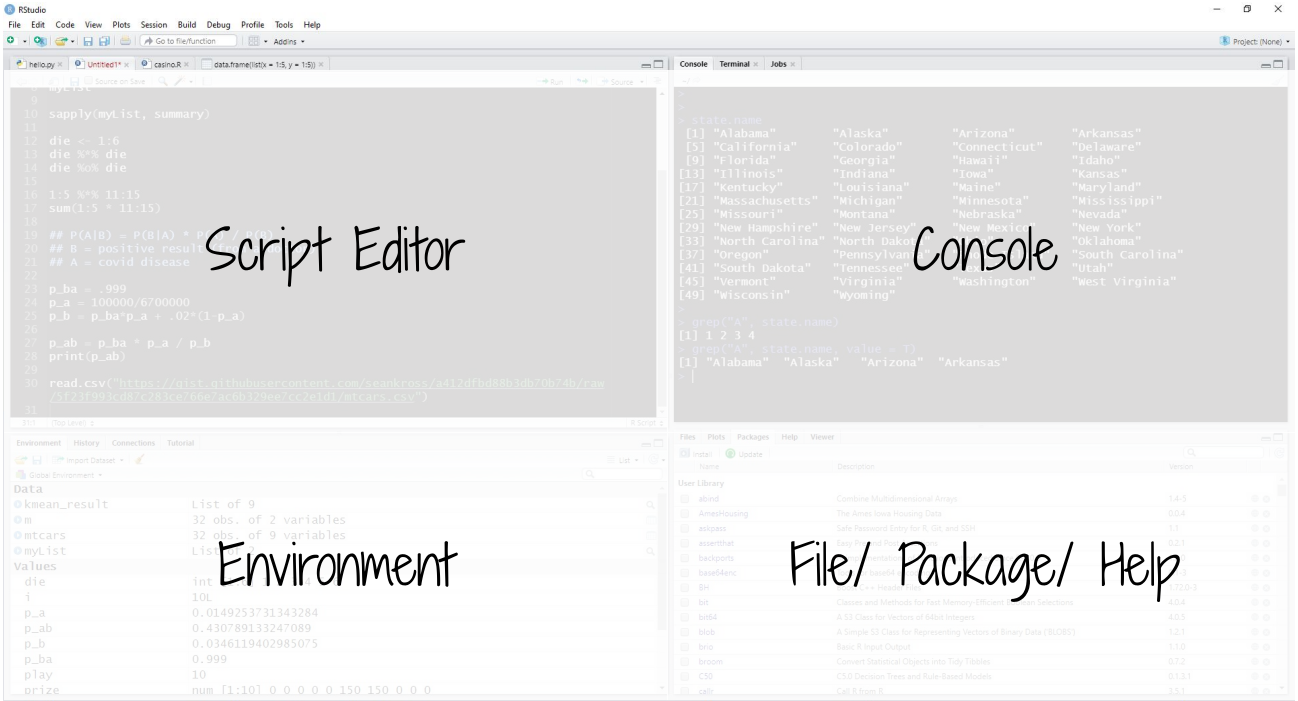
RStudio Desktop IDE

The Comprehensive R Archive Network (r-project.org)

RStudio - RStudio

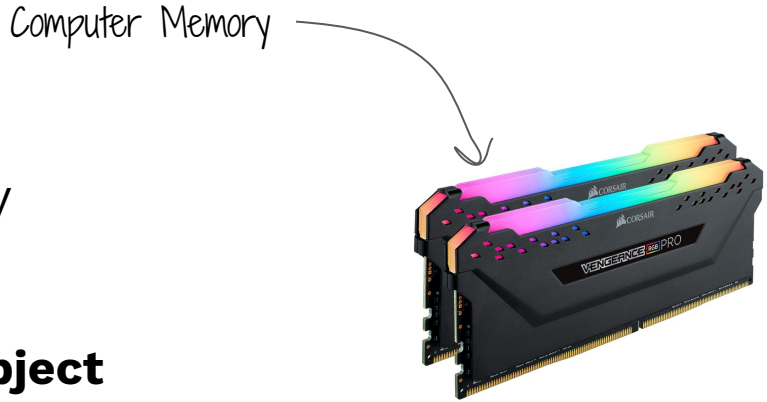


RStudio Desktop IDE



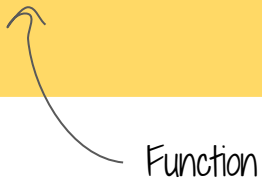
Remember these FACTS

1. R is case sensitive
2. R keeps data in computer memory
3. R is REPL (read, eval, print, loop)
4. Everything that exists in R is an **object**
5. Everything that happens in R is a **function** call



Set up working directory

```
# get working directory
getwd()

# set working directory
setwd("C:/Users/Hello/Desktop/")
```



Basic calculation

```
# simple calculator
1 + 1
5 - 2
5 * 3
6 / 2
10 %% 2
5 ** 2
```

Modulo

power

Create variables

```
# create new variables
income <- 6000
expense <- 3200
saving <- income - expense

# remove variables
rm(saving)
```

Assign operator

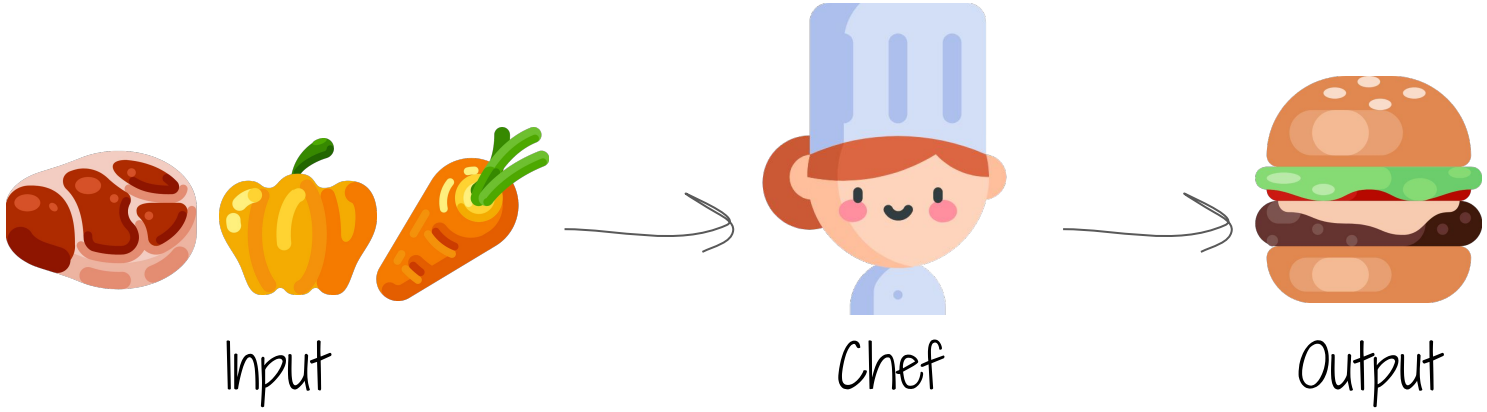
Remove variable

Print characters (string)

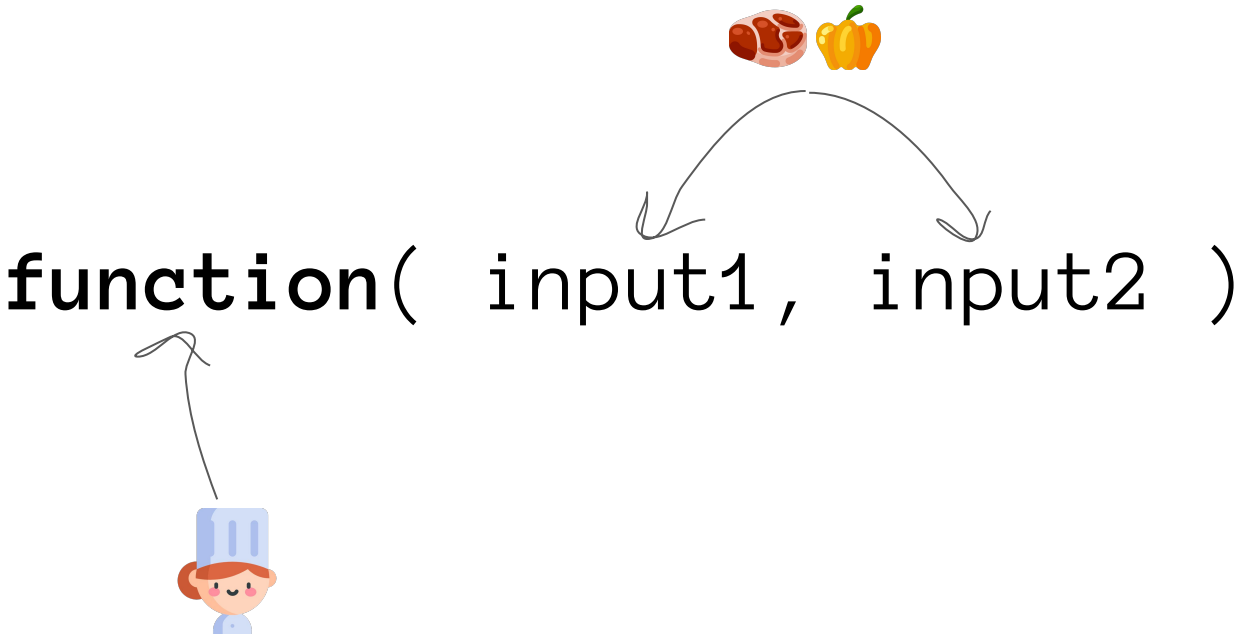
We can use double or single quote (double is preferred)

```
# print hello world
print(“hello world”)
print(‘hello world’)

# there are other functions too
cat(“R is awesome!”)
```

How function works



How function works (R is very similar to Google Sheets)



Create a condition in R

```
# ifelse function in R
score <- 85
ifelse(score >= 80, “Passed”, “Failed”)

# pro tip
ifelse( (score <- 85) >= 80, “Passed”, “Failed”)
```

Assign variable on the fly

Data types

What is the class (type) of this variable?

```
# numeric
class(100)

# character
class("Hello World")

# logical
class(TRUE) # FALSE
```

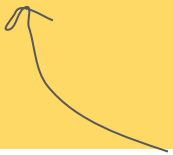
Data types - Factor

```
# create an animal factor
animal <- c("cat", "dog", "hippo", "cat", "dog")

# convert animal to factor
animal <- as.factor(animal)
class(animal)
```

Change from character to factor

Change data types

```
# is to check class/ type
is.character(100)

# as to convert class/ type
x <- 100
x <- as.character(x)
```



Change from numeric to character

TRUE is 1 and FALSE is 0

```
# relationship between numeric and logical
1 == TRUE
0 == FALSE

# we can summarize logical vector
sum( c(T, T, F, F, T) )  ## sum( c(1,1,0,0,1) )
mean( c(T, T, F, F, T) )
```

Compare values in R

```
# compare using these operators
1 + 1 == 2
5 * 2 != 20
5 > 2
5 >= 2
5 < 10
5 <= 10
“Hello” == “hello”
```

What is data structures?

Data structures - vector

concat values

```
# create simple vector with c()
numbers <- c(100, 120, 250, 300, 550)
friends <- c("David", "John", "Anna")

# rep() to replicate
rep("Hello", 10)

# seq() to generate sequence
seq(from = 1, to = 100, by = 2)
```

Data structures - matrix

```
# create matrix from vector
numbers <- c(100, 120, 150, 200, 290, 300)
dim(numbers) <- c(2, 3)

# create using matrix()
m1 <- matrix(1:6, ncol=2, byrow=TRUE)
```

Data structures - list

List can keep a lot of data, different types

```
# create a customer using list
customer_01 <- list(
    fname = “David”,
    lname = “Beckham”,
    age = 42,
    favourite_food = c(“Apple”, “Tom Yum”),
    avg_spending = 5600,
    currency = “US Dollar”
)
```

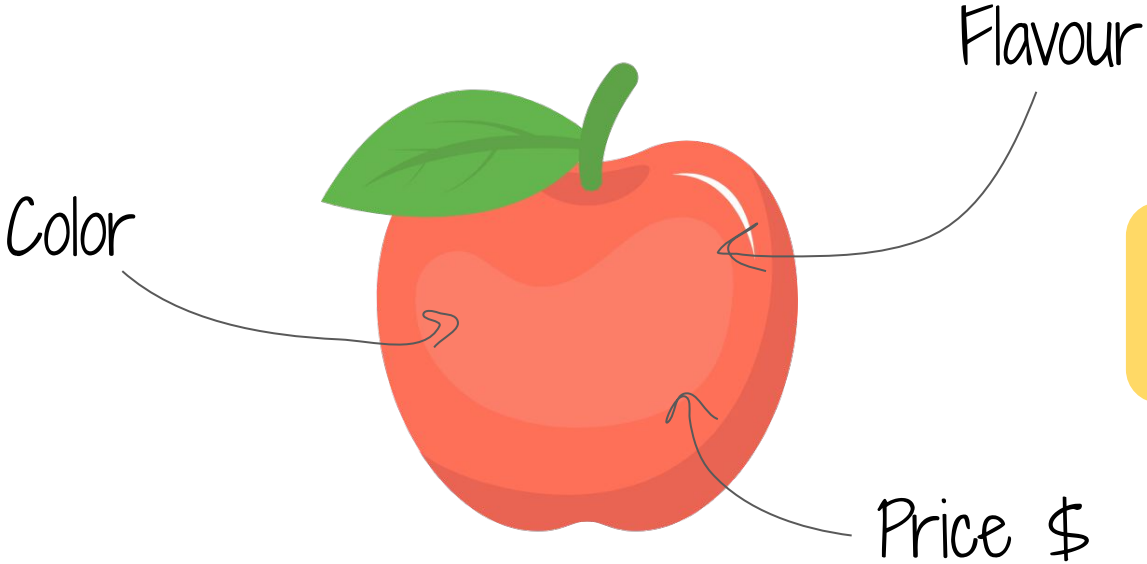
Data structures - data frame

	A	B	C	D	E	F	G	H
1	species	island	bill_length_mm	bill_depth_mm	flipper_length_mm	body_mass_g	sex	year
2	Adelie	Torgersen	39.1	18.7	181	3750	male	2007
3	Adelie	Torgersen	39.5	17.4	186	3800	female	2007
4	Adelie	Torgersen	40.3	18	195	3250	female	2007
5	Adelie	Torgersen	NA	NA	NA	NA	NA	2007
6	Adelie	Torgersen	36.7	19.3	193	3450	female	2007
7	Adelie	Torgersen	39.3	20.6	190	3650	male	2007
8	Adelie	Torgersen	38.9	17.8	181	3625	female	2007
9	Adelie	Torgersen	39.2	19.6	195	4675	male	2007
10	Adelie	Torgersen	34.1	18.1	193	3475	NA	2007
11	Adelie	Torgersen	42	20.2	190	4250	NA	2007
12	Adelie	Torgersen	37.8	17.1	186	3300	NA	2007
13	Adelie	Torgersen	37.8	17.3	180	3700	NA	2007
14	Adelie	Torgersen	41.1	17.6	182	3200	female	2007
15	Adelie	Torgersen	38.6	21.2	191	3800	male	2007
16	Adelie	Torgersen	34.6	21.1	198	4400	male	2007
17	Adelie	Torgersen	36.6	17.8	185	3700	female	2007
18	Adelie	Torgersen	38.7	19	195	3450	female	2007
19	Adelie	Torgersen	42.5	20.7	197	4500	male	2007
20	Adelie	Torgersen	34.4	18.4	184	3325	female	2007
21	Adelie	Torgersen	46	21.5	194	4200	male	2007
22	Adelie	Biscoe	37.8	18.3	174	3400	female	2007
23	Adelie	Biscoe	37.7	18.7	180	3600	male	2007
24	Adelie	Biscoe	35.9	19.2	189	3800	female	2007

Data structures - data frame

```
# create vectors with same length
id <- 1:5
friends <- c("David", "John", "Anna", "Barry", "Garth")
ages <- c(30, 25, 22, 32, 29)
gender <- factor(c("M", "M", "F", "M", "M"))
movie_lover <- c(TRUE, TRUE, TRUE, FALSE, FALSE)

# create a new dataframe
data.frame(id, friends, ages, gender, movie_lover)
```

Everything that exists in R is an object




```
apple$color
apple$flavour
apple$price
```

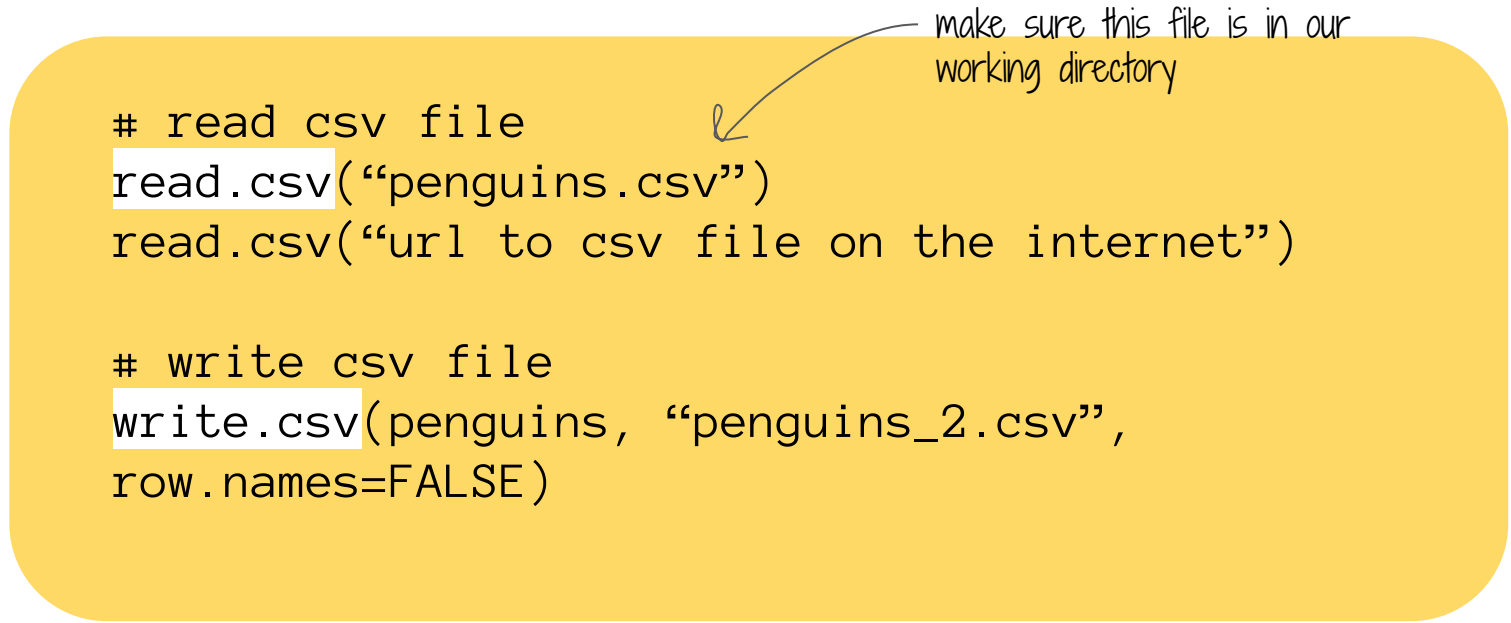
Get data from a data frame using $ [] or [[]]

```
# get a column you want
mtcars$mpg
mtcars[“mpg”]
mtcars[[“mpg”]]

# do some stats
mpg <- mtcars$mpg
mean(mpg); median(mpg); sum(mpg)
```

different operator return different data structure

R is full of statistics functions

Read and write CSV data from RStudio

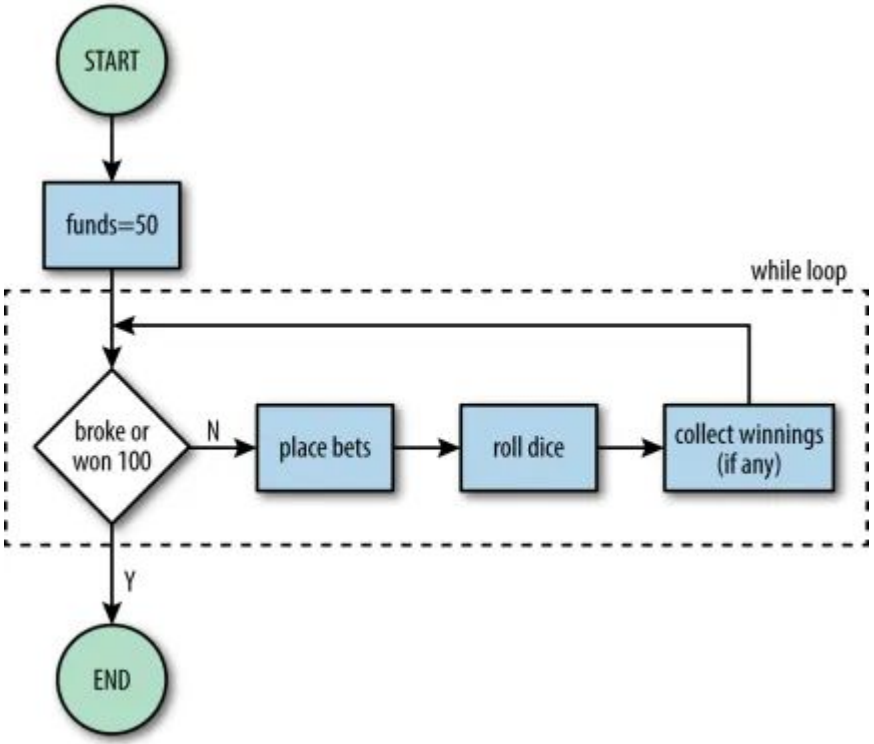


Subset using []

```
# create a vector
friends = c(David = 30, John = 28, Marry = 25)

# subset by position
friends[1]

# subset by condition
friends[ friends < 30 ]

# subset by name
friends[ “David” ]
```

We use [ ] to subset information

What is control flow?



We can write code to control our program behaviours

```
If
For
While
```

Control flow - if

```
# if else block
score <- 85

if (score >= 80) {
    print("Passed")
} else {
    print("Failed")
}
```

Control flow - for

We know how many times the loop with run

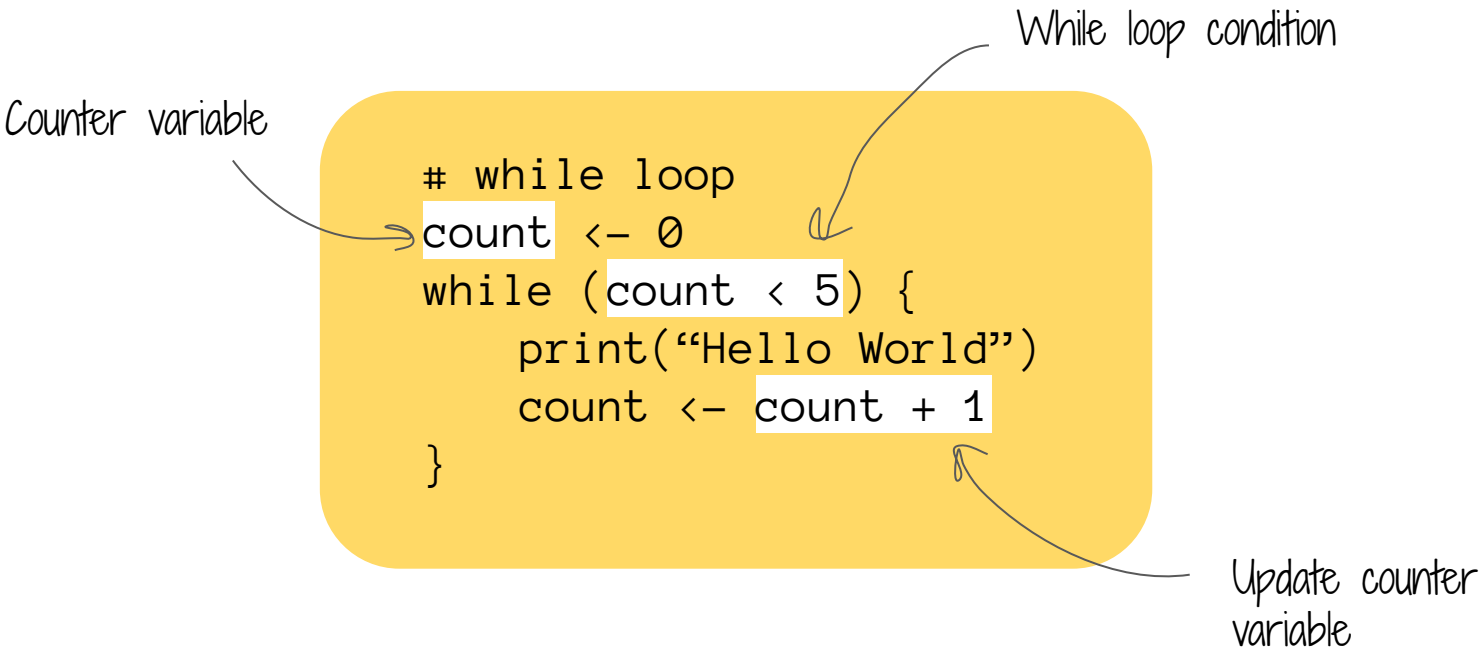
```
# for loop
friends <- c("David", "John", "Mary")

for (friend in friends) {
    print(paste("Hello!", friend))
}
```

Control flow - while

```
# while loop

while (TRUE) {
    do something
}
```

We (might not) know how many times the loop with run

Control flow - while



Get text input from a user

readline() gets character input

```
# get input from user
user_name <- readline("What is your name?: ")
cat("Hello", user_name)

# convert input to numeric if needed
age <- readline("How old are you?: ")
age <- as.numeric(age)
age * 2
```

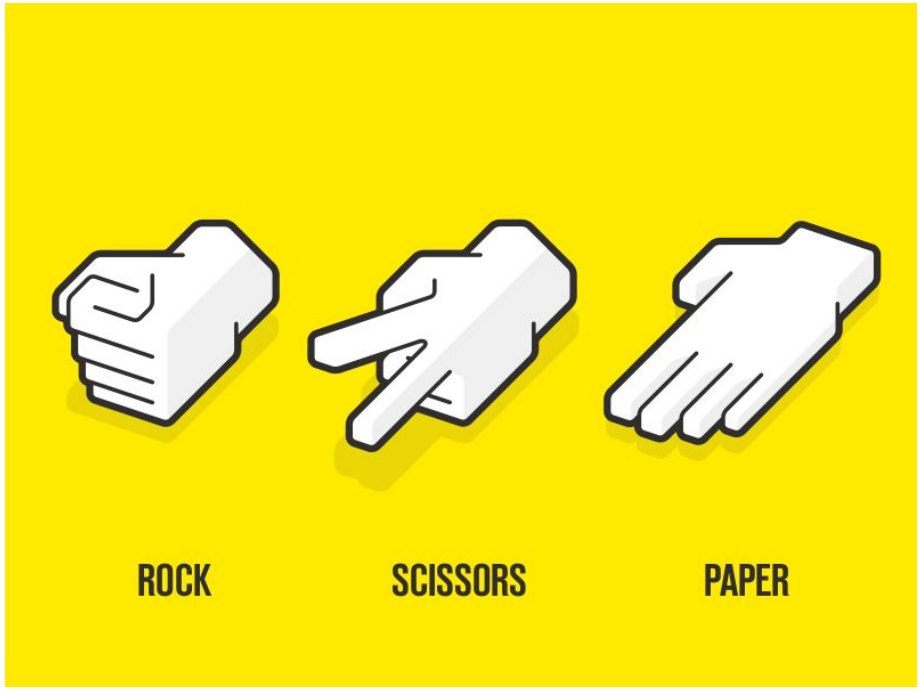
Create your own functions

```
# create a simple function
add_two_nums <- function(a, b) {
    a + b
}

# power function
my_power <- function(base, power=2) {
    base ** power
}
```

function keyword

default argument

Project 01 - Rock Scissors Paper



We will write this game

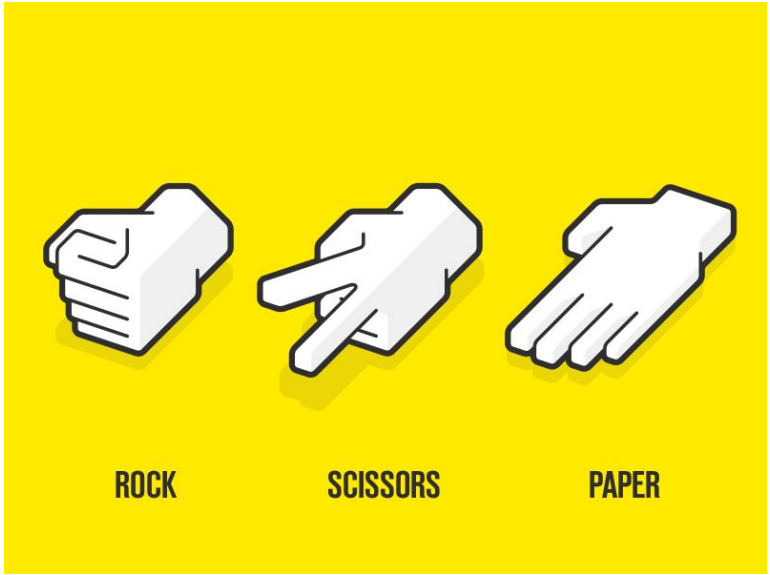
Rock Scissors Paper

Play against computer (random)

Keep track of wins, losses, and ties

We learn through building hands-on projects

```r
# Rock Paper Scissors
# Rock = 1, Paper = 2, Scissors = 3, Exit = 4

actions <- c("Rock", "Paper", "Scissors", "Exit")
win <- 0
loss <- 0
tie <- 0

while (TRUE) {
    player_move <- as.numeric(readline("Choose your move: Rock[1], Paper[2], Scissors[3], Exit[4]: "))
    if (player_move == 4) {
      cat("Good Bye!")
      break
    }

    player_move <- actions[player_move]
    computer_move <- actions[sample(1:3, 1)]

    if (player_move == computer_move) {
      tie <- tie + 1
    } else if (player_move == "Rock" & computer_move == "Paper") {
      loss <- loss + 1
    } else if (player_move == "Paper" & computer_move == "Scissors") {
      loss <- loss + 1
    } else if (player_move == "Scissors" & computer_move == "Rock") {
      loss <- loss + 1
    } else {
      win <- win + 1
    }

    cat("Player Move:", player_move, "\n")
    cat("Computer Move:", computer_move, "\n")
    cat(win, loss, tie)
}
```

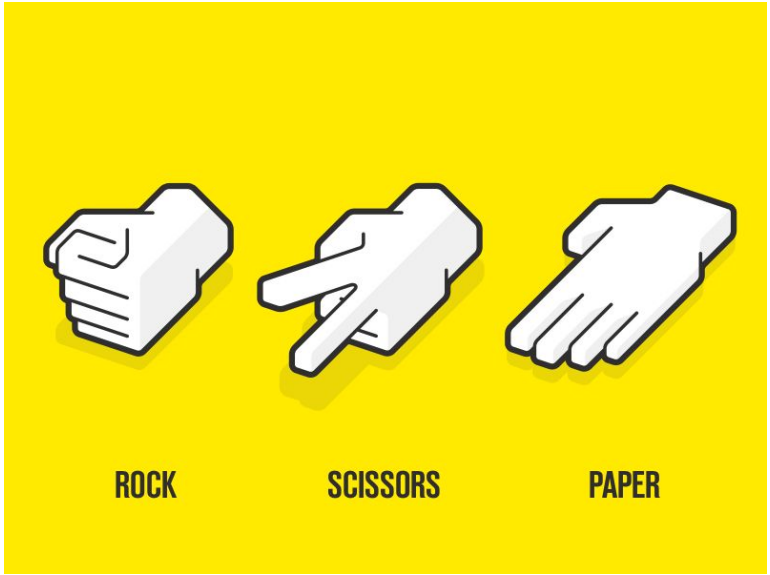


Refactoring Your Code

```
# Rock Paper Scissors
# Rock = 1, Paper = 2, Scissors = 3, Exit = 4

actions <- c("Rock", "Paper", "Scissors", "Exit")
win <- 0
loss <- 0
tie <- 0

while (TRUE) {
    player
    if (pl
      cat(
      brea
    }

    player
    comput

    if (pl
      tie
    } else
      loss
    } else
      loss
    } else
      loss <- loss + 1
    } else {
      win <- win + 1
    }

    cat("Player Move:", player_move, "\n")
    cat("Computer Move:", computer_move, "\n")
    cat(win, loss, tie)
}
```

Make your code more Readable

1. Write code first version
2. Improve your code



You can search for pattern with Regular Expression

Google Sheets is the best! You can use it for free, 0$ cost.

Find G__ S__

G[a-z]+ S[a-z]+

Google Sheets is the best! You can use it for free, 0$ cost.

Find 0-9 number

Google Sheets is the best! You can use it for free, 0$ cost.

[0-9]

Regular Expression Basics

`^A`	`Ant, Amsterdam, America`
`s$`	`Toys, SNSDs, APPLEs`
`c.t`	`cat, cot, cet, cCt, c8t`

Regular Expression Character Class

```
[ABC]  match A B or C
[A-Z]  match all capital letters
[A-z]  match all letters
[a-z]  match all lowercase letters
[0-9]  match digits
```

Regular Expression Quantifiers

```
*       match zero or more
+       match one or more
?       match zero or one
{5}     match exactly 5 characters
{3,5}   match min 3, max 5 characters
```

Regular expression - Wikipedia

More Examples :)

```
[0-9]{5}          match exactly 5 digits
apples?           apple, apples
^[AB][0-9]{4}     A1150, B2324, A3599
```

Basic regular expression in R

```
# look at state.name
state.name

# find matched string
grep(“A”, state.name)
grepl(“A”, state.name)

# replace A with Aloha
gsub(“A”, “Aloha”, state.name)
```

Find pattern

Replace pattern

Tip - we can extract information using gsub()

```
# create strings
foods <- c("I like hotdog", "I like hamburger")

# get the liked object
gsub("I like ", "", foods)
```

Replace "I like " with empty string, cool huh!?

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