Chapter 1 Markdowns

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How to install R

For Mac users, you can use homebrew to install R by `brew install R` directly.
For other users, go Google yourself.

Declaring a variable:

```
x <- "something"
x
```

Output:

```
"something"
```

While you could also use `=`, it would be "local" only.
`<-` declaration is global fyi, which would be more commonly used.

Vectors

Create a "Vector":

```
1:5
```

or

```
c(1, 2, 3, 4, 5)
```

Output:

```
[1] 1 2 3 4 5
```

This creates a vector with parameters 1, 2, 3, 4, 5

Some functions

Length of a vector

```
length(0:9)
```

Output:

```
[1] 10
```

Mode of a vector

```
mode(1:5)
```

Output:

```
[1] "numeric"
```

Interprete a Vector

We use `x` as an example vector:

```
x <- 1:3
```

Do comparison

```
x < 3
```

Output:

```
[1] TRUE TRUE FALSE
```

Store the results

```
y <- (x < 1)
mode(y)
```

Output:

```
[1] "logical"
```

Note that although y contains boolean, it is still a vector.

Why not trying out this using characters?

```
x <- c("C", "L", "S")
x
mode(x)
```

Output:

```
[1] "C" "L" "S"
[1] "character"
```

Combining 2 or more vectors together

```
x <- 1:3
y <- 0:2
z <- c(x, y) # z is a combination of vectors x and y
z
c(z, x)
```

Output:

```
[1] 1 2 3 0 1 2
[1] 1 2 3 0 1 2 1 2 3
```

Combining different data types into one vector is possible.

```
b <- c("C", "L", "S")
c(x, b)
```

Output:

```
[1] 1 2 3 "C" "L" "S"
```

Getting Vector items

We use `x` as an example vector:

```
x <- 1:3
```

Get the 1st element of the vector

```
x[1]
```

```
[1] 1
```

NOTE: the element number starts from 1 but not 0

Don't do this:

```
x[0]
```

Output: *(returns nothing)*

```
integer(0)
```

Get the 1st and 2nd element of the vector

Considering a vector as an input:

```
x[1:2]
```

Output:

```
[1] 1 2
```

Filtering Vector Items

This get the items satisfying the statement `x==2`

```
x[x==2]
```

Output:

```
[1] 2
```

Output as numeric instead of numeral string

```
y <- c("1", "2", "3")
as.numeric(y)
```

Output:

```
[1] 1 2 3
```

Generating a Vector Using Functions

Sequence

`seq(from, to, by)`
For instance:

```
seq(from = 0, to = 50, by = 25)
# seq(0, 50, 25) # Omitting the parameter names.
```

Output:

```
[1] 0 25 50
```

This generates a vector from 0 to 50, with an interval of 25.

Repeat

`rep(x, times, each)` Where `x` is a vector.
For instance:

```
rep(x = 1:2, times = 2, each = 2)
# rep(1:2, 2, NA, 2) # Omitting the parameter names
```

Output:

```
[1] 1 1 2 2 1 1 2 2
```

This generates a vector repeating each items 2 times, repeating the previous outcome 2 times also.
As the 3rd slot is some parameter else, we use `NA` to use the default value.

How about using vectors as parameters?

```
rep(1:2, c(4, 2))
```

Output:

```
[1] 1 1 1 1 2 2
```

This repeats the first item for 4 times and the second for 2 times. *Pretty smart move*.

Matrix

The function

Let's start by the syntax:
`matrix(data, nrow, ncol, byrow)`

An example

Declare a 3x4 matrix:

```
m <- matrix(1:12, nrow = 3, ncol = 4)
m
```

Output:

```
        [, 1]   [, 4]   [, 7]  [, 10]
[1, ]       1       4       7      10
[2, ]       2       5       8      11
[3, ]       3       6       9      12
```

Related functions

Dimention of a matrix

```
dim(m)
```

Output:

```
[1] 3 4
```

Indicates that m is a 3x4 matrix.

Number of columns and rows

```
nrow(m)
ncol(m)
```

Output:

```
[1] 3
[1] 4
```

Indicates that m has 3 rows and 4 columns.

Extracting elements as vectors

```
m[2, ] # The 2nd row of the matrix
m[, 3] # The 3rd column of the matrix
```

Output:

```
[1] 2 5 8 11
[1] 7 8 9
```

Getting a part of a matrix

Get the first 2 rows and last 3 columns of the matrix

```
m[1:2, 2:4] #
```

Output:

```
         [, 1]   [, 2]   [, 3]
[1 ,]        4       7      10
[2 ,]        5       8      11
```

Exclude the second row of the matrix

```
m[, -2] #
```

Output:

```
        [, 1]   [, 2]   [, 3]   [, 4]
[1 ,]       1       4       7      10
[2 ,]       3       6       9      12
```

Get an element

Get the first col and row item of the matrix

```
m[1, 1]
```

Output:

```
[1] 1
```

Combining 2 matrices together

```
m <- matrix(1:12, nrow = 3, ncol = 4)
m1 <- matrix(1:8, nrow = 2, ncol = 4) # 2, 4
m2 <- matrix(1:6, nrow = 3, ncol = 2) # 3, 2
```

---

rowbind, Append to the bottom of the matrix.

```
rbind(m, m1)
```

Output:

```
        [, 1]   [, 2]   [, 3]   [, 4]
[1, ]       1       4       7      10
[2, ]       2       5       8      11
[3, ]       3       6       9      12
[4, ]       1       3       5       7
[5, ]       2       4       6       8
```

---

colbind, Append to the right of the matrix

```
cbind(m, m2)
```

Output:

```
        [, 1]  [, 2]  [, 3]  [, 4]  [, 5]  [, 6]
[1, ]      1      4      7     10      1      4
[2, ]      2      5      8     11      2      5
[3, ]      3      6      9     12      3      6
```

3D/Multi dimentional "Array"

This is a matrix with 3, 3, 3 as dimention

```
n <- array(data = 1:27, dim = rep(3, 3)) #
n
```

Output:

```
, , 1                   , , 2                      , , 3
     [, 1] [, 2] [, 3]           [, 1] [, 2] [, 3]           [, 1] [, 2]
[, 3]
[1, ]    1     4     7  [1, ]     10    13    16  [1, ]     19    22
25
[2, ]    2     5     8  [2, ]     11    14    17  [2, ]     20    23
26
[3, ]    3     6     9  [3, ]     12    15    18  [3, ]     21    24
27
```

List

The function

`list(*args)`

It can store multiple objects even with different data types.

```
w <- list(matrix(1:9, nrow = 3, ncol = 3), c("A", "B"), 1:3)
w
```

Output:

```
[[1]]
     [,1] [,2] [,3]
[1,]    1    4    7
[2,]    2    5    8
[3,]    3    6    9

[[2]]
[1] "A" "B"

[[3]]
[1] 1 2 3
```

Geting the elements of a list

```
w[[1]]
```

Output:

```
     [,1] [,2] [,3]
[1,]    1    4    7
[2,]    2    5    8
[3,]    3    6    9
```

Or lets have fun having a list in a list.

```
z <- list(list("A", "D", list("Easter eggs")), list("B", "C"))
z[[1]][[3]][[1]]
```

Output:

```
[1] "Easter eggs"
```

Assigning alias

```
names(w) <- c("m", "c", "v")
```

`[[1]]` is now assigned a name "m", use `<list>$<name>` to call it.

```
w$m
```

Output:

```
     [,1] [,2] [,3]
[1,]    1    4    7
[2,]    2    5    8
[3,]    3    6    9
```

Contents of the list:

```
w
```

Output:

```
$m
     [,1] [,2] [,3]
[1,]    1    4    7
[2,]    2    5    8
[3,]    3    6    9

$c
[1] "A" "B"

$v
[1] 1 2 3
```

Unlisting items

```
u <- unlist(w)
u
```

Output:

```
 m1  m2  m3  m4  m5  m6  m7  m8  m9  c1  c2  v1  v2  v3 
"1" "2" "3" "4" "5" "6" "7" "8" "9" "A" "B" "1" "2" "3" 
```

Data frame

An example: Women

Note: "women" is somehow an example of a data frame built in R

```
women
```

	height	weight
1	58	115
2	59	117
3	60	120
4	61	123
5	62	126
6	63	129
7	64	132
8	65	135
9	66	139
10	67	142
11	68	146
12	69	150
13	70	154
14	71	159
15	72	164

Extract a specific column

```
women$weight
```

Output:

```
[1] 115 117 120 123 126 129 132 135 139 142 146 150 154 159 164
```

Filtering

```
women$height[women$weight > 142]
```

Output:

```
[1] 68 69 70 71 72
```

Do calculation

`with(source, statement)`

Example

```
with(women, weight / height)
```

Output:

```
[1] 1.982759 1.983051 2.000000 2.016393 2.032258 2.047619 2.062500
2.076923
[9] 2.106061 2.119403 2.147059 2.173913 2.200000 2.239437 2.277778
```

Data frame [""] vs [[]] vs $

`[""]`: You will need to input the full name of the column
Outputs as a data frame

`[]`: Only numbers are allowed as parameters
Outputs as a data frame

`$`: You don't need to complete the column name
Outputs as a vector

`[[]]`: Only numbers are allowed as parameters
Outputs as a vector

Creating a data frame

`data.frame(**kwargs)` (kwargs stands for sth like `x = y`, `a = b`, take vectors as parameters.)

An example

```
member <- data.frame(
  name = c("Mr. Apple", "LuzeriA", "Orangestar"),
  song = c("GENOCIDER", "RENDA JOCKEY", "Uz")
)
member
```

	name	song
1	Mr. Apple	GENOCIDER
2	LuzeriA	RENDA JOCKEY

	name	song
3	Orangestar	Uz

Factor

The function

`factor(x)`
Especially useful if you have a lot of repeated items in a vector (Save resources)

An example

The following indicates the states of the light switches.

```
grp <- c("on", "off", "on", "off", "50/50", "off")
grp
grp <- factor(grp)
```

Output:

```
[1] "on"    "off"   "on"    "off"   "50/50" "off"
[1] on    off   on    off   50/50 off
Levels: 50/50 off on
```

Factor using Integer identifier

```
as.integer(grp)
```

Output:

```
[1] 3 2 3 2 1 2
```

Only get a vector of levels

```
levels(grp)
```

Output:

```
[1] "50/50" "off"   "on"
```

Redefine the levels

```r
levels(grp) <- c("0.5", "0", "1")
grp
```

Output:

```
[1] 1   0   1   0   0.5 0  
Levels: 0.5 0 1
```

Do logical statements

```r
grp == "0.5"
```

```
[1] FALSE FALSE FALSE FALSE  TRUE FALSE
```

Mode vs Class

Mode

Mode describe the data type
i.e. What the data is, can be text or number

Class

Class describe the object class
i.e. How the data is stored, like in the form of matrix

Approximate storage of numbers

As computers has skill issues, its presentation of floats might be not accurate.

An example

```r
n <- 1:10
1.25 * (n * 0.8) - n # Note that 1.25 * 0.8 = 1
```

Expected output: *all 0s*
Actual output:

```
[1] 0.000000e+00 0.000000e+00 4.440892e-16 0.000000e+00 0.000000e+00
[6] 8.881784e-16 8.881784e-16 0.000000e+00 0.000000e+00 0.000000e+00
```

The error can be observed especially when the result of the operation is somehow limited to a certain value.

Missing values NA

`NA` means this value is **N**ot **A**pplicable. You can create a vector with no values using that.

```
x <- NULL
x[seq(2, 10, 2)] <- seq(2, 10, 2)
x
```

Output:

```
[1] NA  2 NA  4 NA  6 NA  8 NA 10
```

detecting NA items

```
is.na(x)
```

Output:

```
[1]  TRUE FALSE  TRUE FALSE  TRUE FALSE  TRUE FALSE  TRUE FALSE
```

Using `!` to achieve `isnot.na()`

```
!is.na(x)
```

Output:

```
[1] FALSE  TRUE FALSE  TRUE FALSE  TRUE FALSE  TRUE FALSE  TRUE
```

Which allow us to skip the `NA` arguments of a vector:

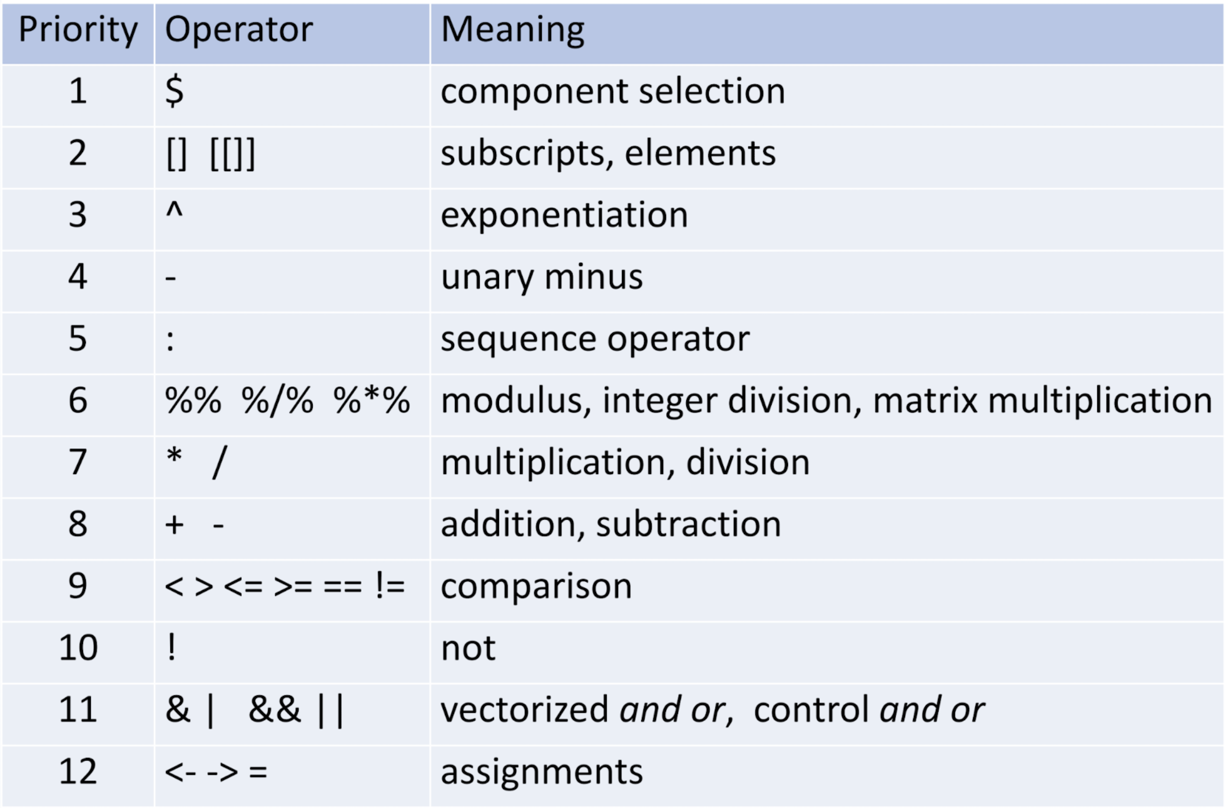
```
x[!is.na(x)]
```

Output:

```
[1]  2  4  6  8 10
```

Operators

Self-explanatory.



Priority	Operator	Meaning
1	$	component selection
2	[] [[]]	subscripts, elements
3	^	exponentiation
4	-	unary minus
5	:	sequence operator
6	%% %/% %*%	modulus, integer division, matrix multiplication
7	* /	multiplication, division
8	+ -	addition, subtraction
9	< > <= >= == !=	comparison
10	!	not
11	& | && ||	vectorized *and or*, control *and or*
12	<- -> =	assignments

Tips: use brackets to ensure clarity!

Built-in functions

There are a lot of pre-built functions in R. Avoid using them as variable names or your program will explode.

Using a built-in function:

`[function name](args, **kwargs)`

```
round(c(3.14, 5.23, 7.777), digits = 1)
```

Output:

```
[1] 3.1 5.2 7.8
```