Introduction to R: Provided by Aboozar Soorni

RStudio layout.

console window
editor window
workspace / history window
files / plots / packages / help window

Assigning values to the objets in R , basic arithmetic functions and a few other handy things to know

Objects are defined with name.

1. Numeric

```
x = 1
print(x)
```

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

```
y <- 7
y
```

```
## [1] 7
```

2. Character

```
xx <- "main" # always between double goutes
xx
```

```
## [1] "main"
```

```
yy <- "1"
yy
```

```
## [1] "1"
```

3. Logical

```
xxx <- TRUE
xxx
```

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

```
yyy <- FALSE
yyy
```

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

To know the objetc type

```
class(xx)
```

```
## [1] "character"
```

R is case sensitive

```
X
Error: object 'X' not found
```

```
Y
Error: object 'Y' not found
```

The number may not apear as the first character in the object name

```
1x <- 22
Error: unexpected symbol in "1x"
```

Commands are separated by ';' or new line.

```
z <- 100; z;
```

```
## [1] 100
```

R would easily overwrite the objects

```
y
```

```
## [1] 7
```

```
y = 9
y
```

```
## [1] 9
```

Ask R to let us know everythins that sorted in the workspace memory (Enveironment)

```
ls()
```

```
## [1] "x"   "xx"  "xxx" "y"   "yy"  "yyy" "z"
```

```
objects()
```

```
## [1] "x"   "xx"  "xxx" "y"   "yy"  "yyy" "z"
```

We may remove an object

```
rm(y)
rm(list=objects())
```

R can be ussed as a calculator

```
11+14
```

```
## [1] 25
```

```
7*9
```

```
## [1] 63
```

```
x = 10
y = 22
x
```

```
## [1] 10
```

```
y
```

```
## [1] 22
```

```
x+y
```

```
## [1] 32
```

```
z <- x+y
x-y
```

```
## [1] -12
```

```
x*y
```

```
## [1] 220
```

```
x/y
```

```
## [1] 0.4545455
```

```
y^2
```

```
## [1] 484
```

```
x^2 + y^2
```

```
## [1] 584
```

```
sqrt(y)
```

```
## [1] 4.690416
```

```
y^(1/2)
```

```
## [1] 4.690416
```

```
log(y)
```

```
## [1] 3.091042
```

```
exp(y)
```

```
## [1] 3584912846
```

```
log2(y)
```

```
## [1] 4.459432
```

```
abs(-14)
```

```
## [1] 14
```

Complet command

```
sqrt(y

)
```

```
## [1] 4.690416
```

R objects and objects types. . . .

1- Vectors.
2- Arrays and Matrices.
3- List and Data frames.

How to create Vectors

```
x <- c(1,3,5,7,9)
x
```

```
## [1] 1 3 5 7 9
```

```r
y <- 1:5
y
```

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

```r
2:7
```

```
## [1] 2 3 4 5 6 7
```

```r
gender <- c("male", "female")
gender
```

```
## [1] "male"   "female"
```

```r
mix <- c(1:3, "blue", TRUE)
mix
```

```
## [1] "1"    "2"    "3"    "blue" "TRUE"
```

```r
OtherVec <- c(x, gender)
OtherVec
```

```
## [1] "1"      "3"      "5"      "7"      "9"      "male"   "female"
```

```r
seq(from = 1, to = 7, by = 1)
```

```
## [1] 1 2 3 4 5 6 7
```

```r
seq(from = 1, to = 7, by = 0.25)
```

```
##  [1] 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00 3.25 3.50 3.75 4.00 4.25
## [15] 4.50 4.75 5.00 5.25 5.50 5.75 6.00 6.25 6.50 6.75 7.00
```

```r
rep(2, times=3)
```

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

```r
rep("marin", times=5)
```

```
## [1] "marin" "marin" "marin" "marin" "marin"
```

```r
rep(1:3, times=3)
```

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

```r
rep(seq(from=2, to = 5, by = 0.25), times=5)
```

```
##  [1] 2.00 2.25 2.50 2.75 3.00 3.25 3.50 3.75 4.00 4.25 4.50 4.75 5.00 2.00
## [15] 2.25 2.50 2.75 3.00 3.25 3.50 3.75 4.00 4.25 4.50 4.75 5.00 2.00 2.25
## [29] 2.50 2.75 3.00 3.25 3.50 3.75 4.00 4.25 4.50 4.75 5.00 2.00 2.25 2.50
## [43] 2.75 3.00 3.25 3.50 3.75 4.00 4.25 4.50 4.75 5.00 2.00 2.25 2.50 2.75
## [57] 3.00 3.25 3.50 3.75 4.00 4.25 4.50 4.75 5.00
```

```r
rep(c("m", "f"), times=3)
```

```
## [1] "m" "f" "m" "f" "m" "f"
```

if two vectors are of the same length, we may add/subtract/mult/div corresponding elements

```r
x + 10
```

```
## [1] 11 13 15 17 19
```

```r
x - 10
```

```
## [1] -9 -7 -5 -3 -1
```

```r
x * 10
```

```
## [1] 10 30 50 70 90
```

```r
x / 10
```

```
## [1] 0.1 0.3 0.5 0.7 0.9
```

```r
x + y
```

```
## [1]  2  5  8 11 14
```

```r
x - y
```

```
## [1] 0 1 2 3 4
```

```r
x * y
```

```
## [1]  1  6 15 28 45
```

```r
x / y
```

```
## [1] 1.000000 1.500000 1.666667 1.750000 1.800000
```

```r
y[3]
```

```
## [1] 3
```

```r
y[-3]
```

```
## [1] 1 2 4 5
```

```r
y[c(1,5)]
```

```
## [1] 1 5
```

```r
y[-c(1,5)]
```

```
## [1] 2 3 4
```

```r
y[y<6]
```

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

How to creat Arrays and matrices

Array : is a vector with a dimention vector with positive values . . . array(vector, dimention)

```r
zxy <- array(c(1:27), dim = c(3,3,3))
zxy
```

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

```
## [1,]   10   13   16
## [2,]   11   14   17
## [3,]   12   15   18
##
## , , 3
##
##      [,1] [,2] [,3]
## [1,]   19   22   25
## [2,]   20   23   26
## [3,]   21   24   27
```

```
zxy[2,2,2] #  a single element
```

```
## [1] 14
```

```
zxy[2,2,] # a vector (1 dimentiona array)
```

```
## [1]  5 14 23
```

```
zxy[2,,] #  a 2 dimention array
```

```
##      [,1] [,2] [,3]
## [1,]    2   11   20
## [2,]    5   14   23
## [3,]    8   17   26
```

```
zxy[,,2] #  a 2 dimention array
```

```
##      [,1] [,2] [,3]
## [1,]   10   13   16
## [2,]   11   14   17
## [3,]   12   15   18
```

```
zxy2 <- c(1:27)
zxy2
```

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

```
dim(zxy2) <- c(3,3,3)
zxy2
```

```
## , , 1
##
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
##
## , , 2
##
##      [,1] [,2] [,3]
## [1,]   10   13   16
## [2,]   11   14   17
## [3,]   12   15   18
##
## , , 3
##
```

```
##      [,1] [,2] [,3]
## [1,]   19   22   25
## [2,]   20   23   26
## [3,]   21   24   27
```

```
class(zxy)
```

```
## [1] "array"
```

```
class(zxy2)
```

```
## [1] "array"
```

```
a <- array(0, dim = c(4,5))
a
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]    0    0    0    0    0
## [2,]    0    0    0    0    0
## [3,]    0    0    0    0    0
## [4,]    0    0    0    0    0
```

```
a1 <- array(1:16, dim = c(4,4))
a1
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    1    5    9   13
## [2,]    2    6   10   14
## [3,]    3    7   11   15
## [4,]    4    8   12   16
```

```
diag(a1)
```

```
## [1]  1  6 11 16
```

```
eigen(a1)
```

```
## $values
## [1]  3.620937e+01 -2.209373e+00  1.599839e-15  7.166935e-16
##
## $vectors
##           [,1]        [,2]       [,3]       [,4]
## [1,] 0.4140028  0.82289268 -0.5477226  0.1125155
## [2,] 0.4688206  0.42193991  0.7302967  0.2495210
## [3,] 0.5236384  0.02098714  0.1825742 -0.8365883
## [4,] 0.5784562 -0.37996563 -0.3651484  0.4745519
```

Matrix : is a vector with 2 dimentions vector with positive values. . . .matrix(vector, 2dimention)
Matrix is special case of an array, because a Matrix is a 2-dimentional array

```
matrix(c(1:9), nrow = 3, ncol = 3)
```

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

```
matrix(c(1:9), nrow = 3, byrow = FALSE)
```

```
##      [,1] [,2] [,3]
```

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

```
matrix(c(1:9), nrow = 3, byrow = TRUE)
```

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

```
mat <- matrix(c(1:9), nrow = 3, byrow = TRUE)
mat[1,2]
```

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

```
mat[c(1,3), 2]
```

```
## [1] 2 8
```

```
mat[2,]
```

```
## [1] 4 5 6
```

```
mat[,1]
```

```
## [1] 1 4 7
```

```
mat * 10
```

```
##      [,1] [,2] [,3]
## [1,]   10   20   30
## [2,]   40   50   60
## [3,]   70   80   90
```

```
matrix(c(1:9), nrow = 3, dimnames = list(c("A","B","C"), c("D","E","F")))
```

```
##   D E F
## A 1 4 7
## B 2 5 8
## C 3 6 9
```

```
x <- c(1,2,3); y <- c(4,5,6)
x; y
```

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

```
## [1] 4 5 6
```

```
col_xy <- cbind(x, y)
col_xy
```

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

```
row_xy <- rbind(x, y)
row_xy
```

```
##   [,1] [,2] [,3]
## x    1    2    3
```

```
## y    4    5    6
```

```
mat
```

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

```
mat^{-1}
```

```
##           [,1]  [,2]      [,3]
## [1,] 1.0000000 0.500 0.3333333
## [2,] 0.2500000 0.200 0.1666667
## [3,] 0.1428571 0.125 0.1111111
```

```
mat
```

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

```
t(mat)
```

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

Lists and DataFrames

Lists : an object containing and ordered collectionof objects known as its components

....list()

```
c <- c("M82", "wonderfull", "Micrtom")
y <- c(2006, 2008)
l <- c(TRUE, FALSE)
a <- array(1:27, dim = c(3,3,3))
m <- matrix(1:9, nrow = 3)

mylist1 <- list(c,y,l,a,m)
mylist1
```

```
## [[1]]
## [1] "M82"        "wonderfull" "Micrtom"
##
## [[2]]
## [1] 2006 2008
##
## [[3]]
## [1]  TRUE FALSE
##
## [[4]]
## , , 1
##
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
```

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

```
mylist1[[5]][2,2]
```

```
## [1] 5
```

```
mylist2 <- list(cultivar = c, year = y, logical = l, array = a, matrix = m)
mylist2
```

```
## $cultivar
## [1] "M82"        "wonderfull" "Micrtom"
##
## $year
## [1] 2006 2008
##
## $logical
## [1]  TRUE FALSE
##
## $array
## , , 1
##
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
##
## , , 2
##
##      [,1] [,2] [,3]
## [1,]   10   13   16
## [2,]   11   14   17
## [3,]   12   15   18
##
## , , 3
##
```

```
##      [,1] [,2] [,3]
## [1,]   19   22   25
## [2,]   20   23   26
## [3,]   21   24   27
##
##
## $matrix
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
```

```
mylist2$matrix[2,2]
```

```
## [1] 5
```

```
length(mylist2)
```

```
## [1] 5
```

```
names(mylist1) <- c("cultivar", "year", "logical", "array", "matrix")
mylist1
```

```
## $cultivar
## [1] "M82"        "wonderfull" "Micrtom"
##
## $year
## [1] 2006 2008
##
## $logical
## [1]  TRUE FALSE
##
## $array
## , , 1
##
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
##
## , , 2
##
##      [,1] [,2] [,3]
## [1,]   10   13   16
## [2,]   11   14   17
## [3,]   12   15   18
##
## , , 3
##
##      [,1] [,2] [,3]
## [1,]   19   22   25
## [2,]   20   23   26
## [3,]   21   24   27
##
##
## $matrix
```

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

DataFrame : Is a list with class "data frame" with the following features :

1. **The components must be vector , factors, matrices , or other dataframes**
2. **Vector structures must all have the same length and matrix structures must all have the same row size**

```
accessions <- c("Alisa craig", "Black cherry", "Comete", "Gnom")
fruit_size <- matrix(c(7,8,5,6,9,7,8,4), ncol = 2, nrow = 4, byrow = TRUE, dimnames = list(accessions, c
fruit_size
```

```
##              2006 2007
## Alisa craig     7    8
## Black cherry    5    6
## Comete          9    7
## Gnom            8    4
```

```
sugar_content <- matrix(c(2.1, 3.2, 3, 2.1, 4.1, 2.3, 2.8, 3.1), ncol = 1, nrow = 4, byrow = TRUE, dimna
sugar_content
```

```
##              2008
## Alisa craig   2.1
## Black cherry  3.2
## Comete        3.0
## Gnom          2.1
```

```
phenome <- data.frame(fruit_size, sugar_content)
phenome
```

```
##              X2006 X2007 X2008
## Alisa craig      7     8   2.1
## Black cherry     5     6   3.2
## Comete           9     7   3.0
## Gnom             8     4   2.1
```

```
c1 <- 1:3
c2 <- c(18,33,66)
c3 <- c("bucky", "tom", "bobby")
x <- data.frame(c1, c2, c3)
x
```

```
##   c1 c2    c3
## 1  1 18 bucky
## 2  2 33   tom
## 3  3 66 bobby
```

```
names(x) <- c("id", "age", "name")
x
```

```
##   id age  name
## 1  1  18 bucky
## 2  2  33   tom
## 3  3  66 bobby
```

```
phenome$X2006
```

```
## [1] 7 5 9 8
```

```
phenome[,1]
```

```
## [1] 7 5 9 8
```

```
phenome[1]
```

```
##              X2006
## Alisa craig      7
## Black cherry     5
## Comete           9
## Gnom             8
```

```
phenome[1,]
```

```
##             X2006 X2007 X2008
## Alisa craig     7     8   2.1
```

```
phenome[1,1:2]
```

```
##             X2006 X2007
## Alisa craig     7     8
```

```
class(phenome)
```

```
## [1] "data.frame"
```

```
class(phenome$X2007)
```

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

```
class(phenome[2])
```

```
## [1] "data.frame"
```

```
class(phenome[,2])
```

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

```
dim(phenome)
```

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

```
nrow(phenome)
```

```
## [1] 4
```

```
ncol(phenome)
```

```
## [1] 3
```

```
head(phenome)
```

```
##              X2006 X2007 X2008
## Alisa craig      7     8   2.1
## Black cherry     5     6   3.2
## Comete           9     7   3.0
## Gnom             8     4   2.1
```

```r
tail(phenome)
```

```
##              X2006 X2007 X2008
## Alisa craig      7     8   2.1
## Black cherry     5     6   3.2
## Comete           9     7   3.0
## Gnom             8     4   2.1
```

```r
phenome$X2009 <- c(4,5,6,9)
phenome
```

```
##              X2006 X2007 X2008 X2009
## Alisa craig      7     8   2.1     4
## Black cherry     5     6   3.2     5
## Comete           9     7   3.0     6
## Gnom             8     4   2.1     9
```
