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Lecture 03 - introduction R

In [2]:

```
a <- 1  
2 -> b  
c = 3
```

In [3]:

```
print(a)  
print(b)  
print(c)
```

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

In [4]:

```
print( paste(a,b,c) )
```

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

In [6]:

```
print( paste(a,b,c, sep = ";" ) )
```

```
[1] "1;2;3"
```

In [7]:

```
b**2
```

```
4
```

In [8]:

```
sqrt(b)
```

```
1.4142135623731
```

In [11]:

```
b**(1/2)
```

```
1.4142135623731
```

In [13]:

```
a+b+c
```

```
6
```

In [14]:

```
a*b*c**2
```

18

In [16]:

```
exp(1)
```

2.71828182845905

In [17]:

```
exp(b)
```

7.38905609893065

Data types

In [79]:

```
a = 3
b = 3.5
c = 1/6
d = "a"
e = "abcd"
f = "I saw a bird."

print(paste(a, class(a)))
print(paste(b, class(b)))
print(paste(c, class(c)))
print(paste(d, class(d)))
print(paste(e, class(e)))
print(paste(f, class(f)))
```

```
[1] "3 numeric"
[1] "3.5 numeric"
[1] "0.166666666666667 numeric"
[1] "a character"
[1] "abcd character"
[1] "I saw a bird. character"
```

In [80]:

```
a = 1/6
b = round(a, 2)
c = round(a)

print(paste(a, class(a)))
print(paste(b, class(b)))
print(paste(c, class(c)))
```

```
[1] "0.166666666666667 numeric"
[1] "0.17 numeric"
[1] "0 numeric"
```

In [81]:

```
a = 3
b = 4
c = (a == b)
d = (a != b)

print(paste(a, class(a)))
print(paste(b, class(b)))
print(paste(c, class(c)))
print(paste(d, class(d)))
```

```
[1] "3 numeric"
[1] "4 numeric"
[1] "FALSE logical"
[1] "TRUE logical"
```

In [85]:

```
intToBits(12)
```

```
[1] 00 00 01 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00
[26] 00 00 00 00 00 00 00 00
```

In [86]:

```
x <- rev(intToBits(12))
x <- paste(as.integer(x), collapse = "")
```

In [96]:

```
x = intToBits(12)
class(x)
typeof(x)
```

'raw'

'raw'

In [94]:

```
suppressWarnings(library(R.utils))

x = intToBin(12)

print(x)
cat(x)
typeof(x)
```

```
[1] "1100"
1100
```

'character'

Operations

In [49]:

```
# addition  
3 + 4
```

7

In [50]:

```
# subtraction  
3 - 4
```

-1

In [51]:

```
# multiplication  
a = 3  
b = 2  
a * b
```

6

In [52]:

```
# division  
a / b
```

1.5

In [68]:

```
a ^ b
```

9

In [69]:

```
a**b
```

9

In [76]:

```
# - - mod  
print(a %% b)  
print(5 %% 2)  
print(5 %% 3)
```

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

In [77]:

```
## integer division  
print(a %% b)  
print(5 %% 2)  
print(5 %% 3)  
print(21 %% 5)
```

```
[1] 1  
[1] 2  
[1] 1  
[1] 4
```

Every variable in R is a vector ou matrix

In [19]:

```
class(a)
```

```
'numeric'
```

In [20]:

```
v = c(1,2,3)  
v
```

```
1 2 3
```

In [22]:

```
class(v)
```

```
'numeric'
```

In [25]:

```
v2 = rep("a",3)  
v2
```

```
'a' 'a' 'a'
```

In [26]:

```
class(v2)
```

```
'character'
```

In [27]:

```
v3 = seq(1,30,2)  
v3
```

```
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29
```

In [28]:

```
class(v3)
```

```
'numeric'
```

Add and Delete elements in a vector

In [29]:

```
v = c(1,2,3)
v
```

```
1 2 3
```

In [30]:

```
v = c(v, c(4,5,6))
v
```

```
1 2 3 4 5 6
```

In [31]:

```
v = v[-(2)]
v
```

```
1 3 4 5 6
```

In [32]:

```
length(v)
```

```
5
```

Filtering elements in a vector

In [33]:

```
v[2:3]
```

```
3 4
```

In [34]:

```
v[2:]
```

```
Error in parse(text = x, srcfile = src): <text>:1:5: unexpected '['
```

```
1: v[2:]
    ^
```

Traceback:

In [35]:

```
v[2:length(v)]
```

```
3 4 5 6
```

Operations in a vector

In [57]:

```
v = 1:10  
v**2
```

```
1  4  9 16 25 36 49 64 81 100
```

In [58]:

```
v*5
```

```
5 10 15 20 25 30 35 40 45 50
```

In [59]:

```
v/2
```

```
0.5 1 1.5 2 2.5 3 3.5 4 4.5 5
```

In [60]:

```
v+3
```

```
4 5 6 7 8 9 10 11 12 13
```

In [61]:

```
3 %in% v
```

```
TRUE
```

In [62]:

```
v == 3
```

```
FALSE FALSE TRUE FALSE FALSE FALSE FALSE FALSE  
FALSE
```

In [63]:

```
which(v == 3)
```

```
3
```

In [65]:

```
v < 4
```

```
TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE  
FALSE
```

In [66]:

```
which(v < 4)
```

```
1 2 3
```

In [67]:

```
v[v < 4]
```

```
1 2 3
```

Matrices

see: <https://www.statmethods.net/advstats/matrix.html> (<https://www.statmethods.net/advstats/matrix.html>).

In [118]:

```
v1 = c(1,2,3)
v2 = c(4,5,6)
v3 = c(7,8,9)

mat = matrix( c(v1,v2,v3), ncol=3, nrow=3)
mat
```

1	4	7
2	5	8
3	6	9

In [119]:

```
mat = matrix( c(v1,v2,v3), ncol=3, nrow=3, byrow = F)
mat
```

1	4	7
2	5	8
3	6	9

In [120]:

```
mat = matrix( c(v1,v2,v3), ncol=3, nrow=3, byrow = T)
mat
```

1	2	3
4	5	6
7	8	9

In [121]:

```
#-- matrix multiplications
mat %*% mat
```

30	36	42
66	81	96
102	126	150

In [122]:

```
#-- determinant
det(mat)
```

```
-9.51619735392994e-16
```

In [126]:

```
#-- trace !!! there is no function trace !!!
tr <- function(data)sum(diag(data))

tr(mat)
```

```
15
```

In [124]:

```
#-- transpose
t(mat)
```

1	4	7
2	5	8
3	6	9

In [127]:

```
#-- inverse == solve -- why?? and why an error?
solve(mat)
```

```
Error in solve.default(mat): system is computationally singular: reciprocal
condition number = 2.20282e-18
Traceback:
```

1. solve(mat)
2. solve.default(mat)

In [128]:

```
v1 = sample.int(100, 3)
v1
```

```
83 3 96
```

In [129]:

```
v2 = sample.int(100, 3)
v3 = sample.int(100, 3)

mat = matrix( c(v1,v2,v3), ncol=3, nrow=3, byrow = T)
mat
```

83	3	96
96	31	90
38	48	47

In [130]:

```
#-- aha !!! why?
solve(mat)
```

-0.03239604	0.050545969	-0.03061952
-0.01235644	0.002862801	0.01975672
0.03881188	-0.043790665	0.02585573

Why always a different result?

because the function is random sampler! it is stochastic

many CTRL+ENTERs

In [140]:

```
v1 = sample.int(100, 3)
v2 = sample.int(100, 3)
v3 = sample.int(100, 3)

mat = matrix( c(v1,v2,v3), ncol=3, nrow=3, byrow = T)
mat
```

47	64	36
68	8	20
37	42	91

How to solve this "problem"?

In [145]:

```
# try any seed value - the answer will be always the same
# computer / mathematical functions are false random number generators
set.seed(3)
```

```
v1 = sample.int(100, 3)
v2 = sample.int(100, 3)
v3 = sample.int(100, 3)

mat = matrix( c(v1,v2,v3), ncol=3, nrow=3, byrow = T)
mat
```

17	80	38
33	60	99
13	30	57