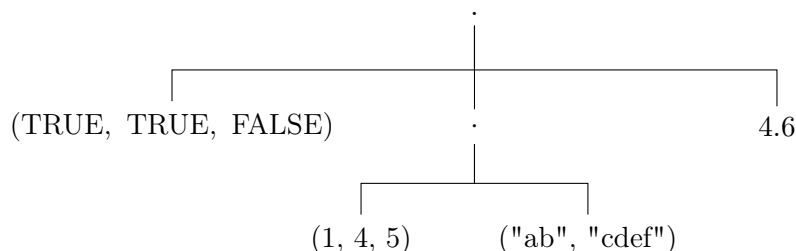


**Ex.1.1.** Generate the following vectors:

- (a) (1, 3, 4)
- (b) (1, 2, 3, ..., 100)
- (c) (1, 3, 5, ..., 99)
- (d) (100, 99, 98, ..., 1)
- (e) (100, 99, 98, ..., 1, 0, -1, -2, -3, -4, -5)

**Ex.1.2.** Create the following objects and check its type.

- (a) (atomic) vectors:
  - i. (5, 5, 6), (1, 2, ..., 49, 50), (50, 49, ..., -4, -5).
  - ii. (1, 5, 6) - it must be an integer.
  - iii. (TRUE, TRUE, FALSE), (TRUE, TRUE, ..., TRUE, FALSE) of length 50.
  - iv. ("quick", "introduction", "to", "R").
- (b) list:



**Ex.1.3.** Creates vectors  $a = (\text{"this", "is", "CS", "lab"})$ , and  $b = (\text{"and", "we", "start", "today"})$ . Create the following vectors based on existing  $a$  or  $b$ . Use `paste()` function.

- (a) "this is CS lab"
- (b) "this.is.CS.lab"
- (c) ("this and", "is we", "CS start", "lab today")
- (d) ("this|and", "is|we", "CS|start", "lab|today")
- (e) "this and is we CS start lab today"
- (f) "this|and is|we CS|start lab|today"
- (g) "this is CS lab and we start today"
- (h) "this is CS lab, we start today"

**Ex.1.4.** Create vector  $x = (1, 2, -3.4, 0, 8.1, 1.9, 12, 0, -1)$ .

- (a) What is the length of  $x$ ?
- (b) Sort (first increasing and then decreasing) elements of  $x$ . What is the difference between `sort()` and `order()` functions?
- (c) Sum elements of  $x$ .
- (d) Find minimum and the maximum element in  $x$ .
- (e) Compute cumulative sums, products, minima or maxima.

- (f) Compute cumulative means.
- (g) Print indices of negative elements. Print negative elements.
- (h) Assign names "a", "b", ... for the elements of  $x$ .
- (i) Print negative elements together with their indices.
- (j) Replace zeros with NAs and compute the sum again.

**Ex.1.5.** Create the following matrix:

$$M = \begin{bmatrix} 1 & 0 & 5 \\ 2 & 1 & 6 \\ 3 & 4 & 0 \end{bmatrix}$$

- (a) What is the dimension of  $M$ ? How many rows, columns does  $M$  have?
- (b) Find transpose of  $M$ .
- (c) Compute square of  $M$ .
- (d) Compute sum of all elements of  $M$ .
- (e) Assign names for rows: "row1", "row2", "row3", and for columns: "col1", "col2", "col3".
- (f) Extract the following subsets:
  - i. element on the position (2, 3)
  - ii. second row
  - iii. first column
  - iv. numbers 2 and 3

Do this exercise in two ways. The first one is in which the selected subset will be a vector. In the second method, the objects must remain a matrix.

- (g) Replace numbers 2 and 3 with 12 and 13 respectively.
- (h) For each column and for each row (separately) compute:
  - i. sums
  - ii. means
  - iii. minimum and maximum
- (i) Compute minimum and the maximum for each row and present it in the following format

	min	max
row1	0	5
row2	1	6
row3	0	4

Note that figures may differ after replacing number 2 and 3 at point (g).

**Ex.1.6.** Familiarize with the `Titanic` built-in dataset.

- (a) What is the type of this object?
- (b) What is the name of the data structure of this object and what is its dimension?
- (c) Subset only adult passengers.

- (d) Subset only male passengers.
- (e) Subset only adult and male passengers.

**Ex.1.7.** Create the following `data.frame` objects and check their types.

(a) 

1	2
5	6
15	36

(b) 

	name	age	student
std1	"Kowalski"	21	TRUE
std2	"Nowak"	23	FALSE

For b, extract the first student `std1`.

**Ex.1.8.** Calculate the values of the following expressions:

- (a)  $e^x \cos(x)$  at  $x = 2, 2.1, 2.2, \dots, 4$ .
- (b)  $\sum_{i=2}^{10} i$
- (c)  $\sum_{i \in \{2, 4, 6, \dots, 100\}} i$
- (d)  $\log(\prod_{k=1}^{50} k)$
- (e)  $\sum_{i=1}^{10} \sum_{j=1}^{20} ij$
- (f)  $\sum_{i=1}^3 \sum_{j=1}^4 ij$
- (g)  $\sqrt{\sum_{i=1}^{10} \sum_{j=1}^{20} ij}$

**Ex.1.9.** Write `minmax(x, n)` function that takes two arguments: vector `x` and an integer `n`, and returns `n` smallest and `n` biggest elements of `x`. If `n` is greater than the length of `x` the function should return a sentence: `"argument too long"`.

**Ex.1.10.** Create a list with two (named) vectors:  $x = (1, 3, 9, 15)$  and  $y = (5, 3, 19)$ . Using `sapply()` (or `lapply()`) function:

- (a) compute the sum of elements for each vector,
- (b) compute the arithmetic mean and the standard deviation for the elements of each the vector.

What is the difference between `sapply()` and `lapply()` functions?

**Ex.1.11.** Plot function  $f(x) = x^3 - x^2 + x - 1$  in the interval  $(-2, 3)$ .

**Ex.1.12.** Familiarize with built-in dataset `cars`. Change units: mph to km/h and ft to meters (1 mile = 1.61 km; 1 feet = 0.3 m). Plot *speed* vs. *dist*.