Exercises for the course
"An introduction to R"
Exercise session Algorithmics: Monday, February 27 2017

**Exercise 1:** What is the value of A, B (and C when relevant) at the end of each algorithm? We assume that the variables A, B and C are already defined as integers.

Algorithm 1:
\[
\begin{align*}
A &\leftarrow 1 \\
B &\leftarrow A + 3 \\
A &\leftarrow 3 \\
\end{align*}
\]
\[A = 3, B = 4\]

Algorithm 2:
\[
\begin{align*}
A &\leftarrow 5 \\
B &\leftarrow 3 \\
C &\leftarrow A + B \\
A &\leftarrow 2 \\
C &\leftarrow B - A \\
\end{align*}
\]
\[A = 2, B = 3, C = 1\]

Algorithm 3:
\[
\begin{align*}
A &\leftarrow 5 \\
B &\leftarrow A + 4 \\
A &\leftarrow A + 1 \\
B &\leftarrow A - 4 \\
\end{align*}
\]
\[A = 6, B = 2\]

Algorithm 4:
\[
\begin{align*}
A &\leftarrow 3 \\
B &\leftarrow 10 \\
C &\leftarrow A + B \\
B &\leftarrow A + B \\
A &\leftarrow C \\
\end{align*}
\]
\[A = 13, B = 13, C = 13\]

Algorithm 5:
\[
\begin{align*}
A &\leftarrow 5 \\
B &\leftarrow 2 \\
A &\leftarrow B \\
B &\leftarrow A \\
\end{align*}
\]
\[A = 2, B = 2\]

**Exercise 2:** Write an algorithm allowing to exchange the values of two variables A and B. At the end of the algorithm, B must have the initial value of A and A must have the initial value of B. We must use a variable C to save the value of A (or B).

Begin
\[
\begin{align*}
A &\leftarrow 5 \\
B &\leftarrow 8 \\
C &\leftarrow A \\
\end{align*}
\]
Exercise 3: Write an algorithm that asks the user for a number and then calculates and prints the square value of this number.

Begin
Write: "Please enter a number:"
Read num
num2 <- num*num
Write num2
End

More refined solution with checking the user entered a number:

Begin
Write: "Please enter a number:"
Read num
While num NO number then
  Write: "Please enter a number:"
  Read num
End While
num2 <- num*num
Write num2
End

Exercise 4: Write an algorithm that asks the user for a number and prints whether this number is positive or negative (don't consider the value 0).

Begin
Write: "Please enter a number:"
Read num
If num > 0 then
  Write "The number is positive"
End If
If num < 0 then
  Write "The number is negative"
End If
End

Upgrade your algorithm including the value 0.

Begin
Write: "Please enter a number:"
Read num
If num > 0 then
  Write "The number is positive"
Else then
  If num = 0 then
    Write "The number is 0"
  Else then

Write "The number is negative"
End If
End If
End

Of course in both cases you can also check if the user really entered a number (as above).

Exercise 5: Write an algorithm asking the user for two numbers and printing whether their product is positive or negative. You should not compute the value of the product.

Begin
Write: "Please enter a first number:
Read num1
Write: "Please enter a second number:
Read num2
If num1 = 0 OR num2 = 0 then
Write "The product is null"
Else then
If (num1 > 0 AND num2 > 0) OR (num1 < 0 AND num2 < 0) then
Write "The product is positive"
Else then
Write "The product is negative"
End If
End If
End

Notice here the use of the parentheses in the condition.

Exercise 6: In a bird species, females from 1 year and above build nests and males from one year and below 6 years also build a nest (to try and attract a female). Other individuals build no nest. Write an algorithm asking for the relevant information about one bird and printing whether it will build a nest or not.

Begin
Write: "Please enter the age of the bird:
Read age
Write: "Please enter the sex of the bird (M/F):
Read sex
Define nest as boolean
If sex = "F" then
  If age < 1 then
    nest <- FALSE
  Else then
    nest <- TRUE
  End If
Else then
  If age < 1 OR age > 5 then
    nest <- FALSE
  Else then
    nest <- TRUE
  End If
End If
If nest = TRUE then
    Write "The bird will build a nest"
Else then
    Write "The bird will not build a nest"
End If
End

Here we could check if the user entered a correct age and sex (not done here to save space).
Notice the use of the nest variable to avoid repeating the Write command in the script (not mandatory of course).
In this case we could save the Else commands by setting the value of nest to TRUE in the first place and changing it only to FALSE when needed.

Exercise 7: Write an algorithm asking the user to enter a number between 1 and 3 and repeating until the answer is correct.
Begin
    Write: "Please enter a number between 1 and 3:"
    Read num
    while (num NO number) OR (num > 3) OR (num < 1) then
        Write: "Not correct: Please enter a number between 1 and 3:"
        Read num
    End While
End

Exercise 8: Write an algorithm asking for an integer, computing the product of all positive integers until this value (factorial of the value) and printing the result.
Begin
    Write: "Please enter an integer:"
    Read int
    Define res as integer
    res <- 1
    For i varying from 1 to int then
        res <- res * i
    End For
    Write: "The factorial value of" & int & "is: " & res.
End

In R there is of course a function factorial that could be used here.