Problem 1 : [to be checked by the teaching assistant before you leave the room]

In this problem, we will build a sequence of pseudo "random" numbers

1. write a new program, which generates 100 random integer numbers and displays them to the terminal, by using the sequence :

$$Z_i = (a * Z_{i-1} + c) \bmod (m)$$

For generating the sequence, use the following parameters:

$$m \quad = \quad 214748$$

$$a \quad = \quad 3145$$

$$c \quad = \quad 4538$$

The sequence is obtained by the initial condition :

$$Z_0 = 10$$

The function modulo for X modulo Y in Fortran is :

$$\bmod (X , Y)$$

From these numbers, obtain a corresponding sequence of numbers between 0 and 1 :

2. re-run your code several time. Are the obtained numbers the same as before? Are they then truly random ?

3. Repeat the same as above, but with $Z_0=9$. How do the obtained numbers compare to your previous ones ? Is there any correspondence between the two sequences of numbers?

4. Sum up a thousand random numbers, and compute the average. What result do you obtain? Is it what you would expect?

5. Write into a file fort.100 the value of the loop index "i" and the random number "r" at each loop cycle. Once obtained, plot the content of fort.100 with the command: **xmgrace fort.100**, or with gnuplot by typing "gnuplot" in the terminal, and then: **p 'fort.100' w lp**.

   what do you observe?

   We now want to describe the experiment of flipping a coin:

6. We want here to modify your function such that it returns a random 0 or 1. Find a simple modification of your code such that it can be achieved.

7. Compute the sum of 1000 random coin flips and obtain the average.

8. We propose now to throw two coins at the same time, and we look at the sum of the two coins (defined as a variable D).

9. Repeat this experiment many times, and obtain for a 1000 experiments (throwing two coins) the corresponding values of D (a thousand different values of D). Compute the average D. What is now the average? How do you explain that?

[Solution of last week problems : see PDF file on KEATS]