COMPUTER STRUCTURE

GRADO EN INGENIERÍA INFORMÁTICA

DOBLE GRADO EN INGENIERÍA INFORMÁTICA Y ADMINISTRACIÓN DE EMPRESAS

uc3m | Universidad Carlos III de Madrid

Grupo de Arquitectura de Computadores

Assignment 1
Introduction to assembly programming (optional part)

Course 2023/2024

Content

Objectives

The objective of this exercise is to introduce the development of code for microcontrollers and to use Creator to execute the code developed in the ESP32-C3 microcontroller.

This microcontroller can be acquired in different platforms by consulting:

https://www.espressif.com/en/products/devkits

The exercise to be performed will consist of applying the function that calculates the factorial of an integer to calculate the factorial of all the elements of a matrix. For this purpose, the function FactorialMatrix will be developed, which accepts the following arguments in the indicated order:

- Address of a matrix (A) of integers, where the values to be calculated are stored.
- Address of a matrix (B) of integers where the results will be stored.
- Number (N) of rows of the matrix.
- Number (M) of columns of the matrix.

The function does not return any result.

This function performs: B[i,j] = factorial(A[i,j]);

For the development of this function we will start from the developments made in the mandatory part of practice 1.

Once the code is developed, the function will be executed using the simulator and the microcontroller several times to count the number of cycles necessary to execute the FactorialMatrix function. The following program will be used as a basis:

```
.data
  A: .word X,X….X    # values for matrix A
  B: .word 0, 0, …0  # values for matrix B
  N: .word valor     # Number of rows
  M: .word valor      # Number of columns


main:
           addi sp, sp -12
           sw ra, 0(sp)
           sw s0, 4(sp)
           sw s1, 8 (sp)

           la a0, A
           la a1, A
           la t0, N
           lw a2, 0(t0)
           la t0, M
           lw a3, 0(t0)

           # the function is executed for the first time
           rdcycle s0
           jal ra factorialMatrix
           rdcycle s1
           sub s1 s1 s0

           # print the number of cycles (s1)

           # the function is executed a second time
           la a0, A
           la a1, A
           la t0, N
           lw a2, 0(t0)
           la t0, M
           lw a3, 0(t0)

           rdcycle s0
           jal ra factorialMatrix
           rdcycle s1
           sub s1 s1 s0

           # print the number of cycles (s1)

           lw ra, 0(sp)
           lw s0, 4(sp)
           lw s1, 8 (sp)
           addi sp, sp 12

           jr ra
```

Once the code has been developed, it will be necessary to test and run the program with matrices of different sizes and the following table will be filled in:

Matrix size	**Cycles in Creator (1st time)**	**Cycles in Creator (2nd time)**	**Cycles en Esp32-c3 (1st time)**	**Cycles en Esp32-c3 (2nd time)**
4x4				
8x8				
16x16				
32x32				

The results obtained will be described and analyzed below.

Submission procedure

The submission of assignment 1 will be done electronically through Aula Global,

The assignment will be done in groups of two students.

The deadline for both **is December 10, 2023 at 23:55 hours.**

It is possible to submit as many times as you want within the given deadline, the only registered version of your assignment is the last one submitted. The evaluation of the assignment is the evaluation of the content of this last submission. Always check what you submit.

Submission: You must submit a single file in **PDF** format with the report (no separate code is required) and the name ec_p1_AAAAAAAAAAAA_BBBBBBBBBBBB.zip where A...A and B...B are the NIA of the group members.

The report will contain:

- The name of the authors of the practice.
- The developed code: factorial function, factorialMatrix and main developed along with a segment of test data.
- Some screenshot of the flash operation output and the monitor output.
- The table with the obtained results and the analysis and conclusions obtained with the development of the practice.

The optional part will add 0.5 points to the final grade of the course.