Microprocessor and Assembly Language Lab: Lab 7

June 24, 2025

1 Two-Dimensional Array

For two-dimensional arrays the same issues are present as before, but the mapping function is slightly more complicated, particularly if the array is not zero-based. The mapping function must also deal with how the rows and columns of the array are to be laid out in memory. For example, a two-dimensional array of three rows and four columns must map onto a linear one-dimensional array of twelve elements, but should the elements in each row or the elements in each column be kept together? Keeping the elements of each row together is called row-major form, and keeping the elements of each column together is called column-major form.

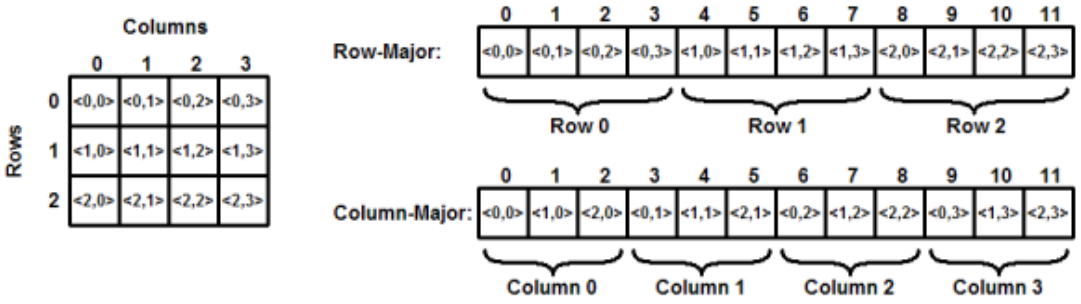

Figure 1:

In the zero-based array shown above, the mapping function from row and column onto linear offset (using row-major form) is:
Offset := 4 * Row + Column
If the column value is in register **R2** and the row is in register **R3**, and the array contains four-byte integers, then the ARM code to load a random element of the array into register **Rx** is as follows:

ADR R5,Buffer ; R5 := Address of Buffer
MOV R1,R3,LSL #2; R1 := R * 4
ADD R1,R1,R2 ; R1 := R * 4 + C
LDR Rx,[R5,R1,LSL #2] ; Rx := Buffer[R1]

2 Your Task

1. Write an assembly language to create a 2D Array. Also use the 2D Array translation formula to access the Array elements making use of register indirect addressing mode.
2. Write an assembly language to perform the multiplication of two matrices.
3. Write an assembly language in which four bytes of data are stored in memory location. Add all data bytes and use register r5 to store any carry generated while adding data bytes by calling a function Add_byte
4. Write an assembly language which convert BCD data to Binary data by calling a function BCD_binary.
5. Write an assembly language to implement a counter to count from '00 – 99' (UP-COUNTER) in BCD and also to generate a delay of one second between the counts.

3 How to calculate 1 second delay of a system

- Lets the clock frequency of your system = C MHz
- Delay count= C/desired time duration (for your case, it is 1sec) = C/1= X clock cycles , which means you have to wait X clock cycles for a 1 sec delay in your program.
- For Linux: Use any of the following
  - lscpu
  - cat /proc/cpuinfo | grep "MHz"
- For Windows
  - Press Ctrl + Shift + Esc to open Task Manager.
  - Go to the Performance tab.
  - Select CPU on the left.
  - Look at the value labeled "Speed"
- For MacOS
  - sysctl -n machdep.cpu.brand_string

4 Submission Guideline

- Your Assembly code with proper comments. (*.s file)
- Screenshot that shows the state of the system after the code has been loaded.
- Screenshot that shows the situation after the code has been executed.
- Submit as a .zip file. Example: your classroll lab#.zip (12 lab2.zip)

5 Submission Deadline

June 26, 2025 @midnight