



Module 2 - Problems:

Processor architecture

Introduction to Computers II

Juan Lanchares Dávila

Fernando Castro Rodríguez

*Dpto. Arquitectura de Computadores y Automática
Universidad Complutense de Madrid*





1) Indicate the result of executing the following instructions in RISC-V, providing the final content of the registers and the memory positions.

- a) add x1,x1,x2
- b) addi x3,x2,2
- c) sub x4,x3,x0
- d) andi x2,x3,0xf0
- e) sll x4,x2,x5
- f) or x1,x1,x2
- g) add x2, x0, x4
- h) lw x1,0(x4)
- i) lw x2,4(x5)
- j) and x5,x1,x3
- k) sw x3,0(x5)
- l) sw x4,4(x4)

Assume that, for each instruction, the initial content of the registers and the memory positions is the following:

Registers		Memory	
x1	0x 0000 0016	0x00	0x 0339 3826
x2	0x 0000 0054	0x04	0x EA00 63AF
x3	0x FFFF FFFF	0x08	0x 17FA 8912
x4	0x 0000 0000	0x0C	0x BC98 3304
x5	0x 0000 0004	0x10	0x 7845 F34A
		0x14	0x 534B 4AAA

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

a) `add x1,x1,x2`

Registers	
x1	0x 0000 006A
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

b) `addi x3,x2,2`

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x 0000 0056
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

c) `sub x4,x3,x0`

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x FFFF FFFF
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

d) `andi x2,x3,0xf0`

Registers	
x1	0x 0000 0016
x2	0x 0000 00F0
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

e) `sll x4,x2,x5`

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0540
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

f) `or x1,x1,x2`

Registers	
x1	0x 0000 0056
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

g) `add x2,x0,x4`

Registers	
x1	0x 0000 0016
x2	0x 0000 0000
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

h) `lw x1,0(x4)`

Registers	
x1	0x 0339 3826
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

i) `lw x2,4(x5)`

Registers	
x1	0x 0000 0016
x2	0x 17FA 8912
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

j) and x5, x1, x3

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0016

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

k) sw x3, 0(x5)

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x FFFF FFFF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x EA00 63AF
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA

l) sw x4, 4(x4)

Registers	
x1	0x 0000 0016
x2	0x 0000 0054
x3	0x FFFF FFFF
x4	0x 0000 0000
x5	0x 0000 0004

Memory	
0x00	0x 0339 3826
0x04	0x 0000 0000
0x08	0x 17FA 8912
0x0C	0x BC98 3304
0x10	0x 7845 F34A
0x14	0x 534B 4AAA



About *Creative Commons*

■ CC license (*Creative Commons*)



- This license enables reusers to distribute, remix, adapt, and build upon the material in any medium or format for noncommercial purposes only, and only so long as attribution is given to the creator. If you remix, adapt, or build upon the material, you must license the modified material under identical terms:



Attribution:

Credit must be given to the creator.



Non commercial:

Only noncommercial uses of the work are permitted.



Share alike:

Adaptations must be shared under the same terms.

More information: <https://creativecommons.org/licenses/by-nc-sa/4.0/>