Course : Computer Organization – ENCM 369

Lab # : Lab 6

Group Submission for : B04

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Exercise A: 12-bit two's complement and RISC-V instructions

Here is a RISC-V assembly language instruction to allocate 28 words on the stack:

```
addi    sp, sp, -112
```

Answer the following questions:

1. What is the machine code for the instruction? Show how you obtained your answer, and express your answer in base two.
2. Suppose before the instruction is run, `sp = 0x7fff_ed80`. A 32-bit adder will compute the new value for `sp`. What are the two 32-bit inputs to the adder, and what is the 32-bit output of the adder? Show how you obtained your answers, and express all your answers in base two.

-112 in 2's complement

0000 - 0111 - 0000

1111 - 1000 - 1111

1111 - 1001 - 0000

Exercise A

addi sp, sp, -112

machine code

-112	sp	func3	sp	op
1111-1001-0000	x2	0	x2	19
1111-1001-0000	00010	000	00010	001 00 11

112 in hex = 16 | 112 0 = 70; 16 | 7 7; 0

0x7fff_ed80

- 70

0x7fff_ed10

= 0111 1111 1111 1111 1110 1101 0001 0000

Exercise B

1) b4, b3 2) d0, e0 3) 78, 0b 4) 35, 2d

2's comp

1) 1011 0100 / 1011 0011 / 0110 0111 — carryout = 1

2) 1101 0000 / 1110 0000 / 1011 0000 — carryout = 1

3) 0111 1000 / 0000 1011 / 1000 0011 — carryout = 0

4) 0011 0101 / 0010 1101 / 0100 0010 — carryout = 0

As two's compliment signed overflow

overflow = yes	no	yes	no
msb is different so sign changes	msb is the same	msb is different so sign changes	msb is the same

As unsigned overflow

overflow yes	yes	no	no
carryout is 1	carryout is 1	carryout is 0	carryout is 0

Exersise E

1) 0x20 , 0x8f 2) 0xc8, 0x6e 3) 0xac, 0xa5 4) 0x26, 0x27

1)
```
  0010 - 0000   a
  1000 - 1111   b
  0111 - 0000   b̄

  1001 - 0001
```
-111

2)
```
  1100 - 1000   a
  0110 - 1110   b
  1001 - 0001   b̄

  0101 - 1010
```
90

3)
```
  1010 - 1100   a
  1010 - 0101   b
  0101 - 1010   b̄

  0000 - 0111
```
7

4)
```
  0010 - 0110   a
  0010 - 0111   b
  1101 - 1000   b̄

  1111 - 1111
```
-1

carry out	0	1	1	0

Signed overflow

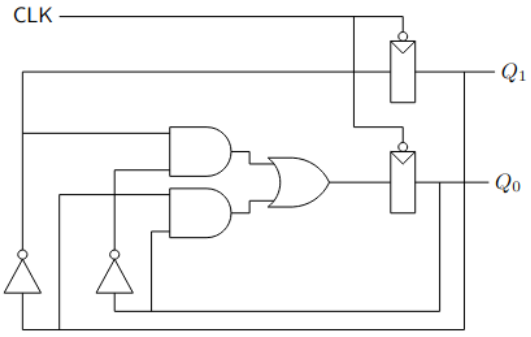
yes	yes	no	no
msb is different so sign changes	msb is different so sign changes	msb is between the values	msb is between the values

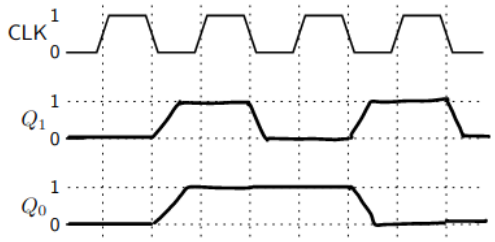
As unsigned overflow

yes	no	no	yes
carryout is 0	carryout is 1	carryout is 1	carryout is 0

Worksheet for Exercise F

Part I





Part II