

### Tutorial 3 – Week of Sep. 27<sup>th</sup> 2021

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#### Question 1) 2.13

Provide the instruction type and hexadecimal representation of the following instruction:

```
sw x5, 32(x30)
```

**Solution:**

S-type

0x025f2023

0000 0010 0101 1111 0010 0000 0010 0011

opcode = 010 0011

imm[4:0] = 0000 0

funct3 = 010

rs1 = 11110

rs2 = 0 0101

imm[11:5] = 0000 001

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imm = imm[11:5] imm[4:0] = 0000 001 0000 0 = 32

#### Question 2) 2.17 (modified)

Assume the following register contents:

x5 = 0x0000AAAA, x6 = 0x12345678

1) For the register values shown above, what is the value of x7 for the following sequence of instructions?

```
slli x7, x5, 4
```

```
or x7, x7, x6
```

2)

For the register values shown above, what is the value of x7 for the following sequence of instructions?

```
srli x7, x5, 3
```

```
andi x7, x7, 0x1EF
```

**Solution:**

1)

```
slli x7, x5, 4 // x7 = 0x000aaaa0  
or x7, x7, x6 // x7 = 0x123efef8
```

2)

```
srlr x7, x5, 3 // x7 = 0x00001555  
andi x7, x7, 0x1EF // x7 = 0x00000145
```

use andi to "and" constant

### Question 3) 2.23

Consider a proposed new instruction named rpt. This instruction combines a loop's condition check and counter decrement into a single instruction. For example

```
rpt x29, loop
```

*loop:* would do the following:

```
if (x29 > 0) {  
    x29 = x29 - 1;  
    goto loop  
}
```

1)

If this instruction were to be added to the RISC-V instruction set, what is the most appropriate instruction format?

2) What is the shortest sequence of RISC-V instructions that performs the same operation?

**Solution:**

**1** The UJ instruction format would be most appropriate because it would allow the maximum number of bits possible for the "loop" parameter, thereby maximizing the utility of the instruction.

**2** It can be done in three instructions:

```
loop:  
    addi x29, x29, -1 // Subtract 1 from x29  
    bgt x29, x0, loop // Continue if x29 not  
                        negative  
    addi x29, x29, 1 // Add back 1 that shouldn't  
                    have been subtracted.
```

#### Question 4) 2.20

For the following C statement, write a minimal sequence of RISC-V assembly instructions that performs the identical operation. Assume `x6` = `A`, and `x17` is the base address of `C`.

```
A = C[0] << 4;
```

#### Solution:

```
ld x6, 0(x17)      // x6 = C[0]
slli x6, x6, 4      // x6 = x6 * 16
```