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2/1/24

**CSE 140 HW #1**

1. No lab partner today

5. **How many bits does a machine instruction contain?**

- A machine instruction contains 32 bits

6. **How many instruction formats are there? What are they? Give 2 operations for each type as examples. If there is any instruction that only has 1 operation, show the 1 operation.**

- There are 6 different instruction formats. They are as follows:

R type: add, and

I type: addi, ori

S type: sb, sd

SB type: beq, bge

U type: auipc, lui

UJ type: jal

7. **Line #53**

a. W**hat instruction type is it? How many fields does this type of instruction have? What are the names of these fields?**

- slli is an I type instruction. This instructiom has 5 different fields. The fields are immediate, rsl, funct3, rd, and Opcode

**b. What are the values of the opcode and function fields of this instruction in Hex? What register is rs1? What is the value of this register in Hex? What register is rd? What is the value of this register in Hex? What immediate value is in Hex?**

- The opcodes value is hex is 13 and the function value is 1. Rs1 is register t3. The value of this register in hex is e. rd is also register t3 which is also e. The immediate value is 2.

**c. Construct the machine code of line #53 using the values obtained from part b. Write your answer in both binary and Hex formats.**

- The answer in hex is 0x002e1e13

- The answer in binary is 0000 0000 0010 1110 0001 1110 0001 0011

8. Now, let’s convert a machine code to a RISC-V instruction by clicking Assemble menu. Locate address 0x0040004C from the Text Segment window.

**a. What is the machine code at this address in Hex? Convert this code into binary.**

- The machine code in hex 0x00000333

- Converted in binary is 0000 0000 0000 0000 0000 0011 0011 0011

**b. From the binary version of this machine code, what is the instruction type? How can you tell? How many fields are there in this instruction type? What are the names of these fields?**

- The instruction type is R. You can tell because the opcode section is 33 which is add and add is a R type instruction. There are 6 fields in this instruction type. The fields are funct7, rs2, rs1, funct3, rd, and Opcode.

**c. According to the binary machine code, what is the value of each field in Hex?**

- funct7: 7 bits (0000000) 0

Rs2: 5 bits (00000) 0

Rs1: 5 bits (00000) 0

Funct3: 3 bits (000) 0

Rd: 5 bits (00110) 6

Opcode: 7 bits (0110011) 33

**d. Refer to the RISC-V sheet, what operation is this instruction? How can you tell? What is the mapping of the registers being used in this instruction?**

- The instruction is the operation add. You can tell by the last 7 bits in the binary or the last 2 numbers in hex. The last 2 numbers in the hex code is 33 which is the add instruction.

**e. What is the final RISC-V instruction? Is it the same as the Source column in the Text Segment window?**

- The last instruction is jr ra. It is the same as the source column in the text segment.

**Individual Work**

**For each instruction, find the instruction type, field names of the instruction type, the values of each field, and finally what instruction it is.**

(0x00400054)

Code – (0x000003b3)

Binary: 0000 0000 0000 0000 0000 0011 1011 0011

Instruction type: R type

Fields:

* Funct7: 7 bits (0000000) 0
* Rs2: 5 bits (00000) 0
* Rs2: 5 bits (00000) 0
* Funct3: 3 bits (000) 0
* Rd: 5 bits (00111) 7
* Opcode: 7 bits (0110011) 33

The instruction is add t1, zero, zero

(0x00400058)

Code – (0x0483d263)

Binary: 0000 0100 1000 0011 1101 0010 0110 0011

Instruction type: SB type

Fields:

* Imm: 7 bits (0000010) 2
* Rs2: 5 bits (01000) 8
* Rs1: 5 bits (00111) 7
* Funct3: 3 bits (101) 5
* Imm: 5 bits (00100) 4
* Opcode: 7 bits (1100011) 63

The instruction is bge t2, s0, ELPJ

(0x00400078)

Code – (0x00072803)

Binary: 0000 0000 0000 0111 0010 1000 0000 0011

Instruction type: I type

Fields:

* Imm: 12 bits (000000000000) 0
* Rs1: 5 bits (01110) E
* Funct3: 3 bits (010) 2
* Rd: 5 bits (10000) 10
* Opcode: 7 bits (0000011) 3

The instruction is lw a6, 0(a4)

(0x00400090)

Code – (0x01072023)

Binary: 0000 0001 0000 0111 0010 0000 0010 0011

Instruction type: S type

Fields:

* Imm: 7 bits (0000000) 0
* Rs2: 5 bits (10000) 10
* Rs1: 5 bits (01110) E
* Funct3: 3 bits (010) 2
* Imm: 5 bits (00000) 0
* Opcode: 7 bits (0100011) 23

The instruction is sw a6, 0(a4)