COMPSCI 2GA3 Tutorial 3 Note

Note:

This note does NOT cover all the materials in Chapter 2 -- Only the ones rated to sample questions of this tutorial are included.

For any questions about the tutorials and courses, feel free to contact me. (Email: wangm235@mcmaster.ca)

GLHF :)

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Machine code & Basic Code & Original Code

e.g.

Machine Code	Basic Code	Original Code
0x00b51463	bne x10 x11 8	bne x10, x11, loop

Note: “loop” is a label. In basic code stage, the label will be automatically translated to immediate value.

```
1 bne x10, x11, loop
2 add x5, x6, x7
3 loop:
```

One thing to remember

All RISC-V instructions are 32 bits!!!

Understand the rs1, rs2, rd2’s location in the original code.

R for registers

R-type

rd rs1 rs2

add x9, x20, x21

S for stores
S-type
rs2 imm rs1
sw x5, 32(x30)

I for immediate
I-type
rd imm rs1
lw x5, 32(x30)

SB for confitional branch, fiels like the S
SB-type
rs1 rs2 imm
bne x10, x11, label

U for upper immediate format
U-type
rd imm
auipc x5, 0x12132
(Note: This is a hex number, but in basic code stage, this number will be automatically translated to immediate value, which is showed as decimal)

Machine Code	Basic Code	Original Code
0x12132297	auipc x5 74034	auipc x5, 0x12132

UJ for unconditional jump
UJ-type
rd imm
jal x11, label

Translate an RISC-V instruction to machine code by hand

1. Search in the instruction list and find the format.
2. Calculate missing data based on above information.
3. Concatenate all fields based on format.
4. Maybe covert it to hexadecimal.

e.g.
add x5, x6, x7
11100110000001010110011

1. Search in the instruction list and find the format.

0000000	rs2	rs1	000	rd	0110011	ADD

2. Calculate missing data based on above information
(Note: in RISC-V, the fields for rs1, rs2 and rd are all 5 bits.)
rd = 5 = 00101
rs1 = 6 = 00110
rs2 = 7 = 00111

3. Concatenate all fields based on format.
0000 0000 0111 0011 0000 0010 1011 0011

4. Maybe covert it to hexadecimal.
0x007302B3

Done. :)