

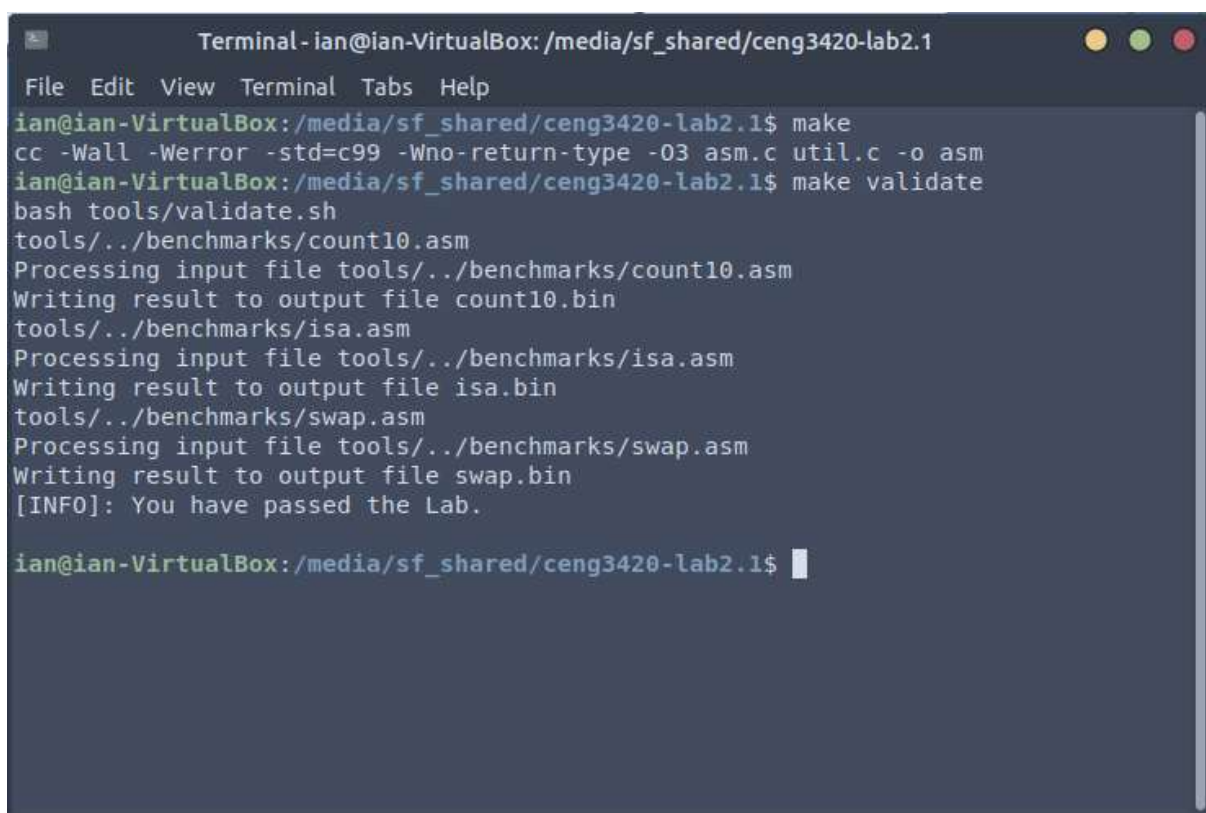
CENG3420 Lab 2 Report

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Lab 2-1:

I implemented the missing part in the asm.c according to the reference documents given. I have encountered a problem when implementing the LUI instruction. I cannot get the immediate value to encode right, I have noticed that in the reference answer provided, the top 20 bits of LUI instructions is always all zeros, but when I use the handle_label_or_imm() function, it always return a non-zero value. At the end, I commented out the line and the output of my assembler can match the reference answer.

Result:

A terminal window titled "Terminal - ian@ian-VirtualBox: /media/sf_shared/ceng3420-lab2.1" with standard window controls. The terminal shows the following commands and output:

```
ian@ian-VirtualBox:/media/sf_shared/ceng3420-lab2.1$ make
cc -Wall -Werror -std=c99 -Wno-return-type -O3 asm.c util.c -o asm
ian@ian-VirtualBox:/media/sf_shared/ceng3420-lab2.1$ make validate
bash tools/validate.sh
tools/./benchmarks/count10.asm
Processing input file tools/./benchmarks/count10.asm
Writing result to output file count10.bin
tools/./benchmarks/isa.asm
Processing input file tools/./benchmarks/isa.asm
Writing result to output file isa.bin
tools/./benchmarks/swap.asm
Processing input file tools/./benchmarks/swap.asm
Writing result to output file swap.bin
[INFO]: You have passed the Lab.

ian@ian-VirtualBox:/media/sf_shared/ceng3420-lab2.1$
```

Lab 2-2:

I implemented all the missing functions opcode decoding function in the sim.c file. I encountered a problem where the load and store instructions only load/store 1 byte, so I wrote the code to load/store them byte by byte. I also encountered a problem where the load/store function would produce results with many leading 1s, i.e 0xffffxxxx. I figured out this might be due to the value is sign extended instead of zero extended. I do not understand why the example LB instruction that is already implemented use sign-extended value. So I stopped using sext() function in other load and store instructions and the simulator outputs the correct answer.

Results:

```
Terminal - ian@ian-VirtualBox: /media/sf_shared/ceng3420-lab2.2
File Edit View Terminal Tabs Help

memory content [0x00000084..0x00000094]:
-----
0x00000084 (132) : 0xffffffff7
0x00000088 (136) : 0x00000000
0x0000008c (140) : 0x00000017
0x00000090 (144) : 0x00000000
0x00000094 (148) : 0xfffffffffee

RISCV LC SIM > rdump

current register/bus values:
-----
instruction count: 32
PC : 0x00400000
registers:
zero [x0]: 0x00000000
ra [x1]: 0x00000040
sp [x2]: 0x00000000
gp [x3]: 0x00000000
tp [x4]: 0x00000000
t0 [x5]: 0x00000000
t1 [x6]: 0x00000000
t2 [x7]: 0x00000000
fp/s0 [x8]: 0x0000007c
s1 [x9]: 0x00000084
a0 [x10]: 0xfffffffffee
a1 [x11]: 0x000000ff
a2 [x12]: 0x000000700
a3 [x13]: 0xfffffffffee
a4 [x14]: 0xffffffff9
a5 [x15]: 0x0000000a
a6 [x16]: 0x0000000d
a7 [x17]: 0x00000068
s2 [x18]: 0x00000000
s3 [x19]: 0x00000000
s4 [x20]: 0x00000000
s5 [x21]: 0x00000000
s6 [x22]: 0x00000000
s7 [x23]: 0x00000000
s8 [x24]: 0x00000000
s9 [x25]: 0x00000000
s10 [x26]: 0x00000000
s11 [x27]: 0x00000000
t3 [x28]: 0x00000000
t4 [x29]: 0x00000000
t5 [x30]: 0x00000000
t6 [x31]: 0x00000000

RISCV LC SIM > 
```

Output of isa.bin

```
Terminal - ian@ian-VirtualBox: /media/sf_shared/ceng3420-lab2.2
File Edit View Terminal Tabs Help
[INFO]: cur_inst = 0x006383b3
[INFO]: cur_inst = 0xffff30313
[INFO]: cur_inst = 0x00031863
[INFO]: cur_inst = 0x006383b3
[INFO]: cur_inst = 0xffff30313
[INFO]: cur_inst = 0x00031863
[INFO]: cur_inst = 0x0000707f
[INFO]: RISCVC LC is halted.

RISCVC LC SIM > rdump

current register/bus values:
-----
instruction count: 35
PC                : 0x00400000
registers:
zero [x0]: 0x00000000
ra   [x1]: 0x00000000
sp   [x2]: 0x00000000
gp   [x3]: 0x00000000
tp   [x4]: 0x00000000
t0   [x5]: 0x00000020
t1   [x6]: 0x00000000
t2   [x7]: 0x00000037
fp/s0 [x8]: 0x0000001c
s1    [x9]: 0x00000000
a0    [x10]: 0x00000000
a1    [x11]: 0x00000000
a2    [x12]: 0x00000000
a3    [x13]: 0x00000000
a4    [x14]: 0x00000000
a5    [x15]: 0x00000000
a6    [x16]: 0x00000000
a7    [x17]: 0x00000000
s2    [x18]: 0x00000000
s3    [x19]: 0x00000000
s4    [x20]: 0x00000000
s5    [x21]: 0x00000000
s6    [x22]: 0x00000000
s7    [x23]: 0x00000000
s8    [x24]: 0x00000000
s9    [x25]: 0x00000000
s10   [x26]: 0x00000000
s11   [x27]: 0x00000000
t3    [x28]: 0x00000000
t4    [x29]: 0x00000000
t5    [x30]: 0x00000000
t6    [x31]: 0x00000000

RISCVC LC SIM >
```

Output of count10.bin

```
Terminal - ian@ian-VirtualBox: /media/sf_shared/ceng3420-lab2.2
File Edit View Terminal Tabs Help
ian@ian-VirtualBox:/media/sf_shared/ceng3420-lab2.2$ ./sim benchmarks/swap.bin
[INFO]: Welcome to the RISCVC LC Simulator

[INFO]: read 60 words (240 bytes) from program into memory.

RISCV LC SIM > mdump 40 60

memory content [0x00000028..0x0000003c]:
-----
0x00000028 (40) : 0x005e2023
0x0000002c (44) : 0x0063a023
0x00000030 (48) : 0x0000707f
0x00000034 (52) : 0x0000abcd
0x00000038 (56) : 0x00001234
0x0000003c (60) : 0x00000000

RISCV LC SIM > go

[INFO]: simulating...

[INFO]: cur_inst = 0x000002b7
[INFO]: cur_inst = 0x03428293
[INFO]: cur_inst = 0x0002a283
[INFO]: cur_inst = 0x00000337
[INFO]: cur_inst = 0x03830313
[INFO]: cur_inst = 0x00032303
[INFO]: cur_inst = 0x000003b7
[INFO]: cur_inst = 0x03438393
[INFO]: cur_inst = 0x00000e37
[INFO]: cur_inst = 0x038e0e13
[INFO]: cur_inst = 0x005e2023
[INFO]: cur_inst = 0x0063a023
[INFO]: cur_inst = 0x0000707f
[INFO]: RISCV LC is halted.

RISCV LC SIM > mdump 40 60

memory content [0x00000028..0x0000003c]:
-----
0x00000028 (40) : 0x005e2023
0x0000002c (44) : 0x0063a023
0x00000030 (48) : 0x0000707f
0x00000034 (52) : 0x00001234
0x00000038 (56) : 0x0000abcd
0x0000003c (60) : 0x00000000

RISCV LC SIM > 
```

Output of swap.bin