

COAL Lab # 06

Load & Store Instruction Assembly Code

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Literature Review:

Load instructions

Load instructions are used to move data from memory to registers (before operation). Loads are encoded in the I-type format. The effective byte address is obtained by adding register rs1 to the sign-extended 12-bit offset. Loads copy a value from memory to register rd. The assembly representation for load instructions are:

`lw (destination_register), (offset)(source_register)`

or

`lw (rd), offset(rs1)`

The LW instruction loads a 32-bit value from memory into rd. LH loads a 16-bit value from memory, then sign-extends to 32-bits before storing in rd. LHU loads a 16-bit value from memory but then zero extends to 32-bits before storing in rd. LB and LBU are defined analogously for 8-bit values.

Store Instructions:

Store instructions are used to move data from registers to memory (after operation). Stores are encoded in the S-type format. The effective byte address is obtained by adding register rs1 to the sign-extended 12-bit offset. Stores copy the value in register rs2 to memory.. The assembly representations for store instructions are:

`sw (source_register_2), (offset)(source_register_1)`

or

`sw (rs2), offset(rs1)`

The SW instruction stores a 32-bit value from the low bits of register rs2 to memory. SH stores a 16-bit value from the low bits of register rs2 to memory. SB stores a 8-bit value from the low bits of register rs2 to memory.

Lab Exercise 01

Task:

Run the below assembly code on Venus Simulator

```
li s0, 0x12345678 # Data to be store
```

```
li s1, 0x00000020 # memory address
```

```
sb s0, 0x0(s1)
```

```
sh s0, 0x4(s1)
```

```
sw s0, 0x8(s1)
```

Machine Code:

```
0000 0000 1000 0100 1000 0000 0010 0011
```

```
0000 0000 1000 0100 1001 0010 0010 0011
```

```
0000 0000 1000 0100 1010 0100 0010 0011
```

Hexa Code:

```
0x00848023
```

```
0x00849223
```

```
0x0084A423
```

Venus Simulation

Venus Editor Simulator Chocopy

Run Step Prev Reset Dump Trace Re-assemble from Editor

PC	Machine Code	Basic Code	Original Code
0x0	0x12345437	lui x0 74565	li x0, 0x12345678
0x4	0x67890413	addi x8 x8 1656	li x0, 0x12345678
0x8	0x01000493	addi x9 x0 32	li s1, 0x00000010
0xc	0x00840023	sb x8 0(x9)	sb s0, 0x0(s1)
0x10	0x00840223	sh x8 4(x9)	sh s0, 0x4(s1)
0x14	0x0084A423	sw x8 8(x9)	sw s0, 0x8(s1)

Registers Memory Cache VDB

Integer (R) Floating (F)

Zero 0x00000000

ra (x1) 0x00000000

sp (x2) 0x7FFFFFFF

gp (x3) 0x00000000

tp (x4) 0x00000000

t0 (x5) 0x00000000

t1 (x6) 0x00000000

t2 (x7) 0x00000000

s0 (x8) 0x12345678

s1 (x9) 0x00000010

a0 (x10) 0x00000000

console output

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Venus Editor Simulator Chocopy

Run Step Prev Reset Dump Trace Re-assemble from Editor

PC	Machine Code	Basic Code	Original Code
0x0	0x12345437	lui x0 74565	li x0, 0x12345678
0x4	0x67890413	addi x8 x8 1656	li x0, 0x12345678
0x8	0x01000493	addi x9 x0 32	li s1, 0x00000010
0xc	0x00840023	sb x8 0(x9)	sb s0, 0x0(s1)
0x10	0x00840223	sh x8 4(x9)	sh s0, 0x4(s1)
0x14	0x0084A423	sw x8 8(x9)	sw s0, 0x8(s1)

Registers Memory Cache VDB

Address	+3	+2	+1	+0
0x00000018	08	00	00	00
0x00000014	00	04	A4	23
0x00000010	00	04	02	23
0x0000000C	00	04	00	23
0x00000008	00	00	04	00
0x00000004	07	04	04	10
0x00000000	12	04	04	37
.....
.....
.....
.....

console output

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Lab Exercise 02

Task:

Run the below assembly code on Venus Simulator

lb t0, 0x0(x0)

lbu t1, 0x4(x0)

lh t2, 0x8(x0)

lhu s0, 0xC(x0)

lw s1, 0x10(x0)

Machine Code:

0000 0000 0000 0000 0000 0010 1000 0011

0000 0000 0100 0000 0100 0011 0000 0011

0000 0000 1000 0000 0001 0011 1000 0011

0000 0000 1100 0000 0101 0100 0000 0011

0000 0001 0000 0000 0010 0100 1000 0011

Hexa Code:

0x00000283

0x00404303

0x00801383

0x00C05403

0x01002483

Venus Simulation

The screenshot displays the Venus simulation interface, which is a web-based tool for simulating a simple computer architecture. The interface is divided into several sections:

- Top Bar:** Contains the Venus logo and navigation tabs: Venus, Editor, Simulator, and Chocopy.
- Assembly Table:** A table showing the current state of the assembly code. It has four columns: PC, Machine Code, Basic Code, and Original Code.
- Memory Dump:** A section on the right showing the current state of memory, with addresses and values.
- Registers:** A section on the right showing the current state of registers, with names and values.
- Console Output:** A section at the bottom left showing the output of the simulation.

The Assembly Table shows the following code:

PC	Machine Code	Basic Code	Original Code
0x0	0x00002B3	lb x5 0(x0)	lb t0, 0(x0)
0x4	0x004043B3	lbu x6 4(x0)	lbu t1, 0x4(x0)
0x8	0x008013B3	lh x7 8(x0)	lh t2, 0x8(x0)
0xC	0x00C054B3	lhu x8 12(x0)	lhu s0, 0xC(x0)
0x10	0x010014B3	lw x9 16(x0)	lw s1, 0x10(x0)

The Memory Dump shows the following values:

Address	Value
0x00000000	00 00 00 00
0x0000002C	00 00 00 00
0x00000028	00 00 00 00
0x00000024	00 00 00 00
0x00000020	00 00 00 00
0x0000001C	00 00 00 00
0x00000018	00 00 00 00
0x00000014	00 00 00 00
0x00000010	00 00 00 00
0x0000000C	00 00 00 00
0x00000008	00 00 00 00
0x00000004	00 00 00 00
0x00000000	00 00 00 00

The Registers section shows the following values:

Register	Value
zero	0x00000000
ra (x1)	0x00000000
sp (x2)	0x7FFFFFFF
gp (x3)	0x00000000
tp (x4)	0x00000000
t0 (x5)	0xFFFFFFFF
t1 (x6)	0x00000001
t2 (x7)	0x00000002
s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x00000000

In Lab Task

Task 1

Write down a simple assembly program to add, and subtract two integer numbers and store their result into different memory locations. Stimulate the code on Venus

Assembly

```
addi x20,x20,0x20 # base address
```

```
addi x18,x18,0x5
```

```
addi x18,x18,0x5 # 5+5
```

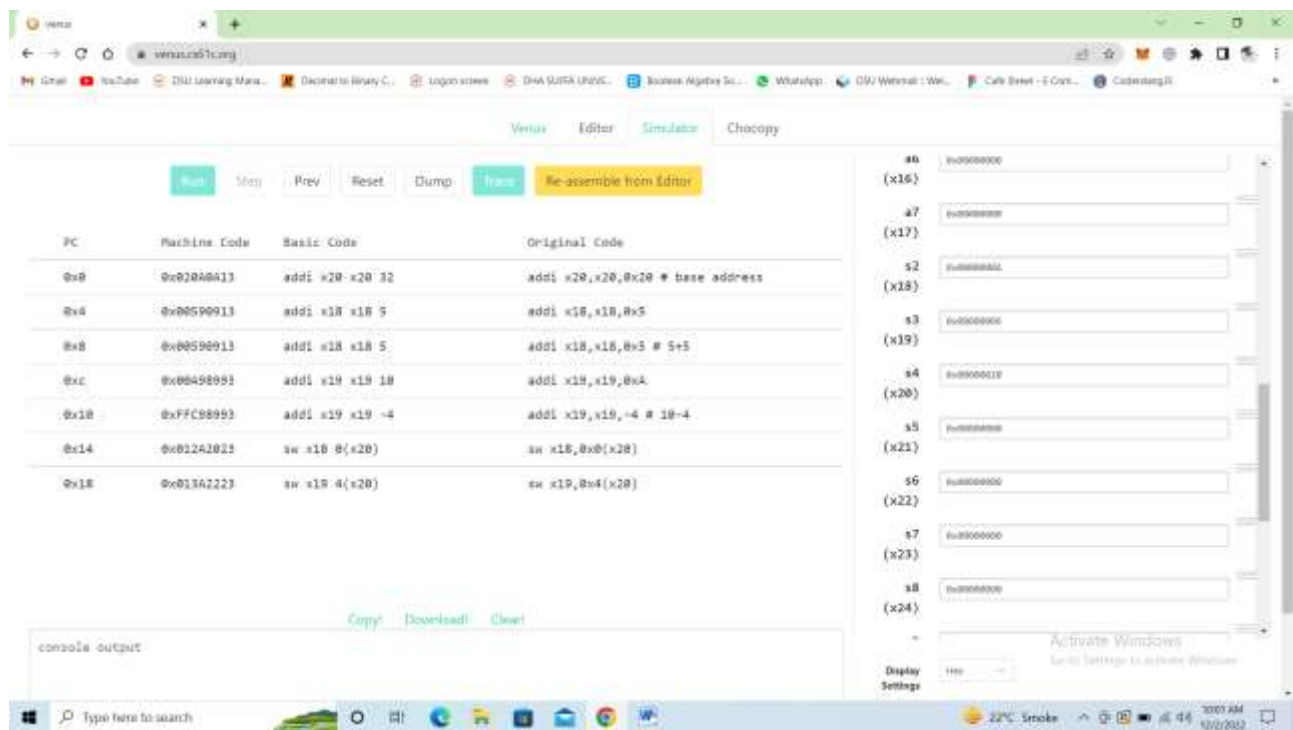
```
addi x19,x19,0xA
```

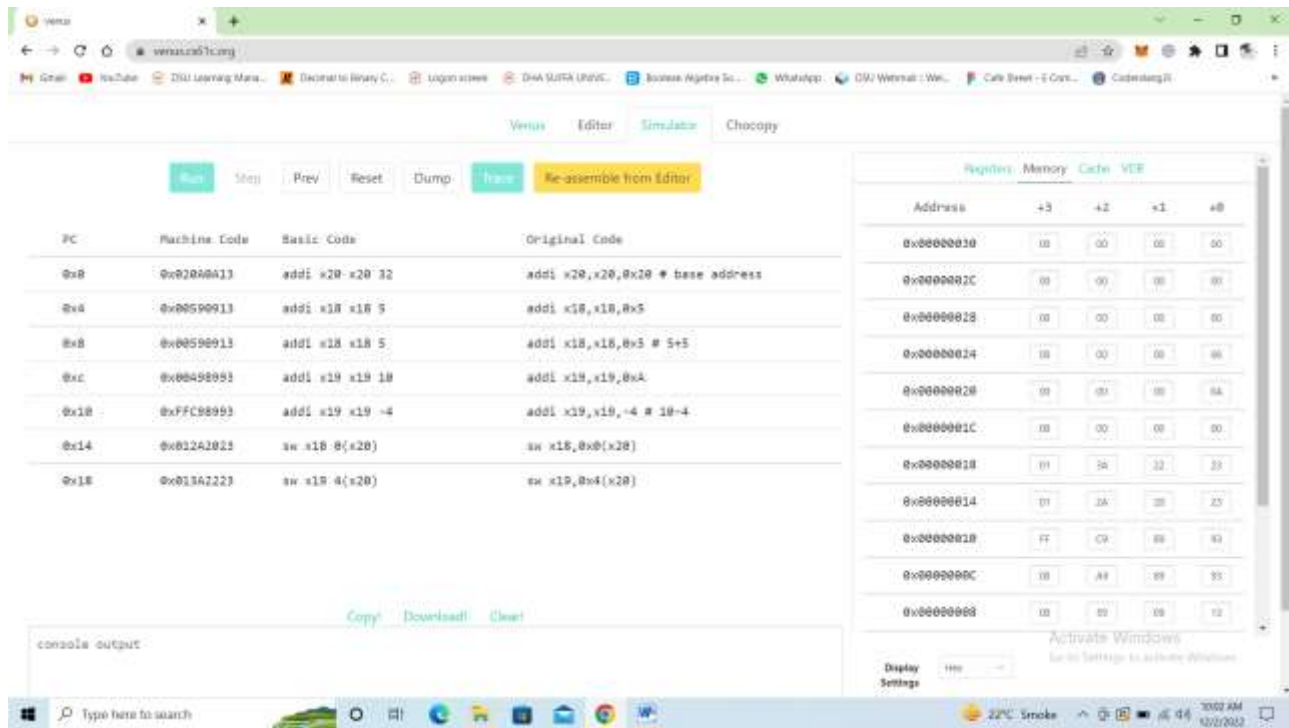
```
addi x19,x19,-4 # 10-4
```

```
sw x18,0x0(x20)
```

```
sw x19,0x4(x20)
```

Venus Simulation





Task 2

Write down a simple assembly program to load the contents from memory into registers and perform the logical operations on them. Stimulate the code on Venus.

Assembly

```
addi x20,x20,0x20 # base address
```

```
lhu x18, 0x0(x20)
```

```
lhu x19, 0x4(x20)
```

```
and x21,x18,x19
```

```
or x22,x18,x19
```

Venus Simulation

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Venus Editor Simulator Chocopy

Run Step Prev Reset Dump trace Re-assemble from Editor

PC	Machine Code	Basic Code	Original Code
0x0	0x02000013	addi x20, x20, 32	addi x20, x20, 0x20 # base address
0x4	0x0000A59B	lhu x18, 0(x20)	lhu x18, 0x0(x20)
0x8	0x004A59B2	lhu x19, 4(x20)	lhu x19, 0x4(x20)
0xC	0x01397AB5	and x21, x18, x19	and x21, x18, x19
0x10	0x01396B53	or x22, x18, x19	or x22, x18, x19

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[ERROR] An error has occurred!

Registers Memory Cache VCE

Address	+3	+2	+1	+0
0x00000010	00	00	00	00
0x0000002C	00	00	00	00
0x00000028	00	00	00	00
0x00000024	00	00	00	00
0x00000020	00	00	00	00
0x0000001C	00	00	00	00
0x00000018	00	00	00	00
0x00000014	00	00	00	00
0x00000010	01	39	AB	53
0x0000000C	01	39	7A	B5
0x00000008	00	4A	59	B2

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Venus Editor Simulator Chocopy

Run Step Prev Reset Dump trace Re-assemble from Editor

PC	Machine Code	Basic Code	Original Code
0x0	0x02000013	addi x20, x20, 32	addi x20, x20, 0x20 # base address
0x4	0x0000A59B	lhu x18, 0(x20)	lhu x18, 0x0(x20)
0x8	0x004A59B2	lhu x19, 4(x20)	lhu x19, 0x4(x20)
0xC	0x01397AB5	and x21, x18, x19	and x21, x18, x19
0x10	0x01396B53	or x22, x18, x19	or x22, x18, x19

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console output

(x16) 0x00000000

47 (x17) 0x00000000

52 (x18) 0x00000000

53 (x19) 0x00000000

54 (x20) 0x00000010

55 (x21) 0x00000000

56 (x22) 0x00000000

57 (x23) 0x00000000

58 (x24) 0x00000000

59 (x25) 0x00000000

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