

Levi de Lima Pereira Junior - 121210472
Roteiro 7

1 - Implementar em Assembly - RISC-V, um programa que calcula o fatorial de um número N.

```
li x1, 1
li x2, 1
li x3, 7
beq x3, zero, fim
loop: beq x1, x3, fim
mul x2, x2, x3
sub x3, x3, x1
jal x0, loop
fim: addi x0, x0, 0
```

The screenshot displays the Venus RISC-V simulator interface within a Mozilla Firefox browser window. The address bar shows the URL <https://venus.kvakil.me>. The interface includes a top navigation bar with 'Editor' and 'Simulator' tabs, and a control bar with 'Run', 'Step', 'Prev', 'Reset', and 'Dump' buttons.

The main area is divided into three columns: 'Machine Code', 'Basic Code', and 'Original Code'. The 'Basic Code' column is currently selected and highlighted in green. Below the code columns is a 'console output' area.

On the right side, there is a 'Registers' panel showing the state of various registers. The 'sp (x2)' register is highlighted with a blue border and contains the value 2147483632. Other registers like 'zero', 'ra (x1)', 'gp (x3)', and 'a0 (x10)' through 'a5 (x15)' are also visible.

Machine Code	Basic Code	Original Code
0x00100093	addi x1 x0 1	li x1, 1
0x00100113	addi x2 x0 1	li x2, 1
0x00500193	addi x3 x0 5	li x3, 5
0x00018a63	beq x3 x0 20	beq x3, zero, fim
0x00300063	beq x1 x3 16	loop: beq x1, x3, fim
0x02310133	mul x2 x2 x3	mul x2, x2, x3
0x401181b3	sub x3 x3 x1	sub x3, x3, x1
0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

Registers:

- zero: 0
- ra (x1): 0
- sp (x2): 2147483632
- gp (x3): 268435456
- tp (x4): 0
- t0 (x5): 0
- t1 (x6): 0
- t2 (x7): 0
- s0 (x8): 0
- s1 (x9): 0
- a0 (x10): 0
- a1 (x11): 0
- a2 (x12): 0
- a3 (x13): 0
- a4 (x14): 0
- a5 (x15): 0

Display Settings: Decimal

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Editor

Simulator

Run

Step

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Reset

Dump

Machine Code	Basic Code	Original Code
0x00100093	addi x1 x0 1	li x1, 1
0x00100113	addi x2 x0 1	li x2, 1
0x00500193	addi x3 x0 5	li x3, 5
0x00018a63	beq x3 x0 20	beq x3, zero, fim
0x00300863	beq x1 x3 16	loop: beq x1, x3, fim
0x02310133	mul x2 x2 x3	mul x2, x2, x3
0x401181b3	sub x3 x3 x1	sub x3, x3, x1
0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers

Memory

zero

0

ra (x1)

1

sp (x2)

2147483632

gp (x3)

268435456

tp (x4)

0

t0 (x5)

0

t1 (x6)

0

t2 (x7)

0

s0 (x8)

0

s1 (x9)

0

a0 (x10)

0

a1 (x11)

0

a2 (x12)

0

a3 (x13)

0

a4 (x14)

0

a5 (x15)

0

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10:50

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Editor

Simulator

Run

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Reset

Dump

Machine Code	Basic Code	Original Code
0x00100093	addi x1 x0 1	li x1, 1
0x00100113	addi x2 x0 1	li x2, 1
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0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers

Memory

zero

0

ra (x1)

1

sp (x2)

1

gp (x3)

268435456

tp (x4)

0

t0 (x5)

0

t1 (x6)

0

t2 (x7)

0

s0 (x8)

0

s1 (x9)

0

a0 (x10)

0

a1 (x11)

0

a2 (x12)

0

a3 (x13)

0

a4 (x14)

0

a5 (x15)

0

Display Settings

Decimal

10:51

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Editor Simulator

Run Step Prev Reset Dump

Machine Code	Basic Code	Original Code
0x00100093	addi x1 x0 1	li x1, 1
0x00100113	addi x2 x0 1	li x2, 1
0x00500193	addi x3 x0 5	li x3, 5
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0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fin: addi x0, x0, 0

console output

Registers Memory

zero	0
ra (x1)	1
sp (x2)	1
gp (x3)	5
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

Display Settings Decimal



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Run Step Prev Reset Dump

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0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fin: addi x0, x0, 0

console output

Registers Memory

zero	0
ra (x1)	1
sp (x2)	1
gp (x3)	5
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

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Editor

Simulator

Run

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Reset

Dump

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console output

Registers

Memory

zero	0
ra (x1)	1
sp (x2)	1
gp (x3)	5
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

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Dump

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0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers

Memory

zero	0
ra (x1)	1
sp (x2)	5
gp (x3)	5
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

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0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers

Memory

zero	0
ra (x1)	1
sp (x2)	5
gp (x3)	4
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

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console output

Registers

Memory

zero	0
ra (x1)	1
sp (x2)	5
gp (x3)	4
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

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0x00500193	addi x3 x0 5	li x3, 5
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0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers Memory

zero	0
ra (x1)	1
sp (x2)	5
gp (x3)	4
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

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Editor Simulator

Run Step Prev Reset Dump

Machine Code	Basic Code	Original Code
0x00100093	addi x1 x0 1	li x1, 1
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0x00500193	addi x3 x0 5	li x3, 5
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0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers Memory

zero	0
ra (x1)	1
sp (x2)	20
gp (x3)	4
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

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Machine Code	Basic Code	Original Code
0x00100093	addi x1 x0 1	li x1, 1
0x00100113	addi x2 x0 1	li x2, 1
0x00500193	addi x3 x0 5	li x3, 5
0x00018a63	beq x3 x0 20	beq x3, zero, fim
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0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers

Memory

zero	0
ra (x1)	1
sp (x2)	20
gp (x3)	3
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

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0x00100093	addi x1 x0 1	li x1, 1
0x00100113	addi x2 x0 1	li x2, 1
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0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers

Memory

zero	0
ra (x1)	1
sp (x2)	20
gp (x3)	3
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

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Reset

Dump

Machine Code	Basic Code	Original Code
0x00100093	addi x1 x0 1	li x1, 1
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0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers

Memory

zero

0

ra (x1)

1

sp (x2)

20

gp (x3)

3

tp (x4)

0

t0 (x5)

0

t1 (x6)

0

t2 (x7)

0

s0 (x8)

0

s1 (x9)

0

a0 (x10)

0

a1 (x11)

0

a2 (x12)

0

a3 (x13)

0

a4 (x14)

0

a5 (x15)

0

Display Settings

Decimal

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Editor

Simulator

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Step

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Reset

Dump

Machine Code	Basic Code	Original Code
0x00100093	addi x1 x0 1	li x1, 1
0x00100113	addi x2 x0 1	li x2, 1
0x00500193	addi x3 x0 5	li x3, 5
0x00018a63	beq x3 x0 20	beq x3, zero, fim
0x00300863	beq x1 x3 16	loop: beq x1, x3, fim
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0x401101b3	sub x3 x3 x1	sub x3, x3, x1
0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers

Memory

zero

0

ra (x1)

1

sp (x2)

60

gp (x3)

3

tp (x4)

0

t0 (x5)

0

t1 (x6)

0

t2 (x7)

0

s0 (x8)

0

s1 (x9)

0

a0 (x10)

0

a1 (x11)

0

a2 (x12)

0

a3 (x13)

0

a4 (x14)

0

a5 (x15)

0

Display Settings

Decimal

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Editor Simulator

Run Step Prev Reset Dump

Machine Code	Basic Code	Original Code
0x00100093	addi x1 x0 1	li x1, 1
0x00100113	addi x2 x0 1	li x2, 1
0x00500193	addi x3 x0 5	li x3, 5
0x00018a63	beq x3 x0 20	beq x3, zero, fim
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0x401181b3	sub x3 x3 x1	sub x3, x3, x1
0xff5ff06f	jai x0 -12	jai x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers Memory

zero	0
ra (x1)	1
sp (x2)	60
gp (x3)	2
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

Display Settings Decimal

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Editor Simulator

Run Step Prev Reset Dump

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0x00100093	addi x1 x0 1	li x1, 1
0x00100113	addi x2 x0 1	li x2, 1
0x00500193	addi x3 x0 5	li x3, 5
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0x401181b3	sub x3 x3 x1	sub x3, x3, x1
0xff5ff06f	jai x0 -12	jai x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers Memory

zero	0
ra (x1)	1
sp (x2)	60
gp (x3)	2
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

Display Settings Decimal

LOAC 2022.1: Roteiro 7

venus

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Editor Simulator

Run Step Prev Reset Dump

Machine Code	Basic Code	Original Code
0x00100093	addi x1 x0 1	li x1, 1
0x00100113	addi x2 x0 1	li x2, 1
0x00500193	addi x3 x0 5	li x3, 5
0x00018a63	beq x3 x0 20	beq x3, zero, fim
0x00300863	beq x1 x3 16	loop: beq x1, x3, fim
0x02310133	mul x2 x2 x3	mul x2, x2, x3
0x401101b3	sub x3 x3 x1	sub x3, x3, x1
0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers Memory

zero	0
ra (x1)	1
sp (x2)	60
gp (x3)	2
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

Display Settings Decimal



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Editor Simulator

Run Step Prev Reset Dump

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0x00100113	addi x2 x0 1	li x2, 1
0x00500193	addi x3 x0 5	li x3, 5
0x00018a63	beq x3 x0 20	beq x3, zero, fim
0x00300863	beq x1 x3 16	loop: beq x1, x3, fim
0x02310133	mul x2 x2 x3	mul x2, x2, x3
0x401101b3	sub x3 x3 x1	sub x3, x3, x1
0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers Memory

zero	0
ra (x1)	1
sp (x2)	120
gp (x3)	2
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

Display Settings Decimal



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Editor Simulator

Run Step Prev Reset Dump

Machine Code	Basic Code	Original Code
0x00100093	addi x1 x0 1	li x1, 1
0x00100113	addi x2 x0 1	li x2, 1
0x00500193	addi x3 x0 5	li x3, 5
0x00018a63	beq x3 x0 20	beq x3, zero, fim
0x00300863	beq x1 x3 16	loop: beq x1, x3, fim
0x02310133	mul x2 x2 x3	mul x2, x2, x3
0x401181b3	sub x3 x3 x1	sub x3, x3, x1
0xff5ff06f	jai x0 -12	jai x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers Memory

zero	0
ra (x1)	1
sp (x2)	120
gp (x3)	1
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

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Editor Simulator

Run Step Prev Reset Dump

Machine Code	Basic Code	Original Code
0x00100093	addi x1 x0 1	li x1, 1
0x00100113	addi x2 x0 1	li x2, 1
0x00500193	addi x3 x0 5	li x3, 5
0x00018a63	beq x3 x0 20	beq x3, zero, fim
0x00300863	beq x1 x3 16	loop: beq x1, x3, fim
0x02310133	mul x2 x2 x3	mul x2, x2, x3
0x401181b3	sub x3 x3 x1	sub x3, x3, x1
0xff5ff06f	jai x0 -12	jai x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers Memory

zero	0
ra (x1)	1
sp (x2)	120
gp (x3)	1
tp (x4)	0
t0 (x5)	0
t1 (x6)	0
t2 (x7)	0
s0 (x8)	0
s1 (x9)	0
a0 (x10)	0
a1 (x11)	0
a2 (x12)	0
a3 (x13)	0
a4 (x14)	0
a5 (x15)	0

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Editor

Simulator

Run

Step

Prev

Reset

Dump

Machine Code	Basic Code	Original Code
0x00100093	addi x1 x0 1	li x1, 1
0x00100113	addi x2 x0 1	li x2, 1
0x00500193	addi x3 x0 5	li x3, 5
0x00018a63	beq x3 x0 20	beq x3, zero, fim
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0x02310133	mul x2 x2 x3	mul x2, x2, x3
0x401181b3	sub x3 x3 x1	sub x3, x3, x1
0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers

Memory

zero

0

ra (x1)

1

sp (x2)

120

gp (x3)

1

tp (x4)

0

t0 (x5)

0

t1 (x6)

0

t2 (x7)

0

s0 (x8)

0

s1 (x9)

0

a0 (x10)

0

a1 (x11)

0

a2 (x12)

0

a3 (x13)

0

a4 (x14)

0

a5 (x15)

0

Display Settings

Decimal

11:01

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Editor

Simulator

Run

Step

Prev

Reset

Dump

Machine Code	Basic Code	Original Code
0x00100093	addi x1 x0 1	li x1, 1
0x00100113	addi x2 x0 1	li x2, 1
0x00500193	addi x3 x0 5	li x3, 5
0x00018a63	beq x3 x0 20	beq x3, zero, fim
0x00300863	beq x1 x3 16	loop: beq x1, x3, fim
0x02310133	mul x2 x2 x3	mul x2, x2, x3
0x401181b3	sub x3 x3 x1	sub x3, x3, x1
0xff5ff06f	jal x0 -12	jal x0, loop
0x00000013	addi x0 x0 0	fim: addi x0, x0, 0

console output

Registers

Memory

zero

0

ra (x1)

1

sp (x2)

120

gp (x3)

1

tp (x4)

0

t0 (x5)

0

t1 (x6)

0

t2 (x7)

0

s0 (x8)

0

s1 (x9)

0

a0 (x10)

0

a1 (x11)

0

a2 (x12)

0

a3 (x13)

0

a4 (x14)

0

a5 (x15)

0

Display Settings

Decimal

11:02

2 -

- Escrever o valor **0xFE** no endereço da memória de dados **0x1000000C**.
- Ler o valor **0xFE** do endereço da memória de dados **0x1000000C** e escrever no registrador **x10**.

```
li, x11, 0xfe
lui x12, 0x000
lui x12, 0x10000
sw x11, 12(x12)
lw x10, 12(x12)
```

Machine Code	Basic Code	Original Code
0x0fe00593	addi x11 x0 254	li, x11, 0xfe
0x00000637	lui x12 0	lui x12, 0x000
0x10000637	lui x12 65536	lui x12, 0x10000
0x00b62623	sw x11 12(x12)	sw x11, 12(x12)
0x00c62503	lw x10 12(x12)	lw x10, 12(x12)

Register	Value
t0 (x5)	0x00000000
t1 (x6)	0x00000000
t2 (x7)	0x00000000
s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x000000fe
a1 (x11)	0x000000fe
a2 (x12)	0x10000000
a3 (x13)	0x00000000
a4 (x14)	0x00000000
a5 (x15)	0x00000000
a6 (x16)	0x00000000
a7 (x17)	0x00000000
s2 (x18)	0x00000000
s3 (x19)	0x00000000
s4 (x20)	0x00000000

Editor

Simulator

Run

Step

Prev

Reset

Dump

Machine Code	Basic Code	Original Code
0x0fe00593	addi x11 x0 254	li, x11, 0xfe
0x00000637	lui x12 0	lui x12, 0x000
0x10000637	lui x12 65536	lui x12, 0x10000
0x00b62623	sw x11 12(x12)	sw x11, 12(x12)
0x00c62503	lw x10 12(x12)	lw x10, 12(x12)

console output

Registers Memory				
Address	+0	+1	+2	+3
0x10000018	00	00	00	00
0x10000014	00	00	00	00
0x10000010	00	00	00	00
0x1000000c	fe	00	00	00
0x10000008	00	00	00	00
0x10000004	00	00	00	00
0x10000000	00	00	00	00
0x0ffffffc	00	00	00	00
0x0ffffff8	00	00	00	00
0x0ffffff4	00	00	00	00
0x0ffffff0	00	00	00	00
0x0fffffac	00	00	00	00
0x0fffffe8	00	00	00	00

Jump to

-- choose --

Up

Down

Display Settings

Hex