

Levi de Lima Pereira Junior - 121210472
Roteiro 6

```
.text
main:
    addi a0, zero, 1
    add a1, a0, a0
    addi a2, zero, 5
loop:
    beq a0, a2, fim
    slli a1, a1, 1
    addi a0, a0, 1
    j loop
fim:
    nop
```

1. Qual é a operação realizada pelo código acima?

O código faz uma soma imediata entre o valor armazenado no registrador zero (x0) que é 0 e 1 e armazena no registrador a0 (x10).

Depois ele faz uma soma entre o valor armazenado no registrador a0 (x10) e a0 (x10) e armazena em a1 (x11) que será 2.

Depois ele faz uma soma imediata entre 0 (x0) e 5 que dá 5 e armazena no registrador a2 (x12).

Em seguida ele faz uma comparação entre os valores dos registradores a0 (x10) e a2 (x12) e se for igual ele leva para o endereço fim que encerra o código, ou seja, ele pula 16 bytes. Caso ele não passe na condição ele faz um shift para a esquerda no valor do registrador a1 (x11) e armazena no registrador a1 (x11).

Em seguida, ele faz uma soma imediata entre o valor armazenado no registrador a0 (x10) e 1 e armazena o resultado no registrador a0 (x10).

Depois ele faz um jump para o endereço loop, pulando -12 bytes.

2. Qual é o conteúdo (em decimal) dos registradores a0, a1 e a2 ao final da execução do programa?

a0 = 5

a1 = 32

a2 = 5

3. Quais são os valores de loop e fim?

loop: 0000000C

fim: 0000001C

Adicione "prints" da tela do simulador ao arquivo PDF. Esses "prints" deverão mostrar todo o ambiente, incluindo o código em Assembly que foi executado e os valores exibidos na interface após a execução de cada instrução (código de máquina armazenado na memória, valores do pc e dos demais registradores envolvidos).

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0x00c50863	beq x10 x12 16	beq a0, a2, fim
0x00150593	slli x11 x11 1	slli a1, a1, 1
0x00150513	addi x10 x10 1	addi a0, a0, 1
0xff5ff06f	jal x0 -12	j loop
0x00000013	addi x0 x0 0	nop

console output

Registers Memory

zero	0x00000000
ra (x1)	0x00000000
sp (x2)	0x7fffffff
gp (x3)	0x10000000
tp (x4)	0x00000000
t0 (x5)	0x00000000
t1 (x6)	0x00000000
t2 (x7)	0x00000000
s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x00000000
a1 (x11)	0x00000000
a2 (x12)	0x00000000
a3 (x13)	0x00000000
a4 (x14)	0x00000000
a5 (x15)	0x00000000

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t2 (x7)	0x00000000
s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x00000001
a1 (x11)	0x00000000
a2 (x12)	0x00000000
a3 (x13)	0x00000000
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t2 (x7)	0x00000000
s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x00000001
a1 (x11)	0x00000002
a2 (x12)	0x00000000
a3 (x13)	0x00000000
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s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x00000001
a1 (x11)	0x00000004
a2 (x12)	0x00000005
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t0 (x5)	0x00000000
t1 (x6)	0x00000000
t2 (x7)	0x00000000
s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x00000004
a1 (x11)	0x00000010
a2 (x12)	0x00000005
a3 (x13)	0x00000000
a4 (x14)	0x00000000
a5 (x15)	0x00000000

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Machine Code	Basic Code	Original Code
0x00100513	addi x10 x0 1	addi a0, zero, 1
0x00a505b3	add x11 x10 x10	add a1, a0, a0
0x00500613	addi x12 x0 5	addi a2, zero, 5
0x00c50863	beq x10 x12 16	beq a0, a2, fim
0x00159593	slli x11 x11 1	slli a1, a1, 1
0x00150513	addi x10 x10 1	addi a0, a0, 1
0xff5ff06f	jal x0 -12	j loop
0x00000013	addi x0 x0 0	nop

console output

Registers

Memory

zero	0x00000000
ra (x1)	0x00000000
sp (x2)	0x7fffffff
gp (x3)	0x10000000
tp (x4)	0x00000000
t0 (x5)	0x00000000
t1 (x6)	0x00000000
t2 (x7)	0x00000000
s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x00000004
a1 (x11)	0x00000010
a2 (x12)	0x00000005
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console output

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tp (x4)	0x00000000
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t1 (x6)	0x00000000
t2 (x7)	0x00000000
s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x00000005
a1 (x11)	0x00000020
a2 (x12)	0x00000005
a3 (x13)	0x00000000
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0x00000013	addi x0 x0 0	nop

console output

Registers Memory

	zero
ra (x1)	0x00000000
sp (x2)	0x7fffffff
gp (x3)	0x10000000
tp (x4)	0x00000000
t0 (x5)	0x00000000
t1 (x6)	0x00000000
t2 (x7)	0x00000000
s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x00000005
a1 (x11)	0x00000020
a2 (x12)	0x00000005
a3 (x13)	0x00000000
a4 (x14)	0x00000000
a5 (x15)	0x00000000

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0x00a505b3	add x11 x10 x10	add a1, a0, a0
0x00500613	addi x12 x0 5	addi a2, zero, 5
0x00c50863	beq x10 x12 16	beq a0, a2, fim
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0x00150513	addi x10 x10 1	addi a0, a0, 1
0xff5ff06f	jal x0 -12	j loop
0x00000013	addi x0 x0 0	nop

console output

Registers Memory

	zero
ra (x1)	0x00000000
sp (x2)	0x7fffffff
gp (x3)	0x10000000
tp (x4)	0x00000000
t0 (x5)	0x00000000
t1 (x6)	0x00000000
t2 (x7)	0x00000000
s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x00000005
a1 (x11)	0x00000020
a2 (x12)	0x00000005
a3 (x13)	0x00000000
a4 (x14)	0x00000000
a5 (x15)	0x00000000

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2 - Implementar, a partir do arquivo inst.101, o trecho de código abaixo para RISC-V.

```
0x00200513
0x00400593
0x00b50663
0x00a50633
0x0080006f
0x00b58633
0x00000013
```

```
00000000 00010 00000 000 01010 0010011
addi x10, zero, 2
00000000 00100 00000 000 01011 0010011
addi x11, zero, 4
00000000 01011 01010 000 01100 1100011
beq x10, x11, 12
00000000 01010 01010 000 01100 0110011
add x12, x10, x10
0000000010000000000000 00000 1101111
jal x0, 8
00000000 01011 01011 000 01100 0110011
add x12, x11, x11
00000000 00000 00000 000 00000 0010011
addi x0, x0, 0
```

```
addi x10, zero, 2
addi x11, zero, 4
beq x10, x11, 12
add x12, x10, x10
jal x0, 8
add x12, x11, x11
addi x0, x0, 0
```

ou

```
addi x10, zero, 2
addi x11, zero, 4
beq x10, x11, jump
add x12, x10, x10
jal x0, fim
jump: add x12, x11, x11
fim: addi x0, x0, 0
```

1. Qual é a operação realizada pelo código acima?

Primeiro ele faz uma soma imediata entre o valor armazenado no registrador x0 e o número 2 e atribui o resultado ao registrador x10.

Depois ele faz uma soma imediata entre o valor do registrador x0 e o número 4 e atribui o resultado ao registrador x11.

Depois ele verifica se os valores dos registradores x10 e x11 são iguais, caso sejam iguais ele dá um salto de 12 bytes e caso não seja continua a execução de forma sequencial.

Em seguida, ele faz uma soma entre os valores armazenados nos registradores x10 e x11 e atribui o resultado ao registrador x12.

Ele não faz a execução do armazenamento no registrador x12 para a soma sucessiva entre o valor armazenado no registrador x11 pois o jump fez com que pulasse 8 bytes, ou seja, para a próxima instrução em seguida.

Depois ele faz um JAL (Jump) de 8 bytes para finalizar a execução.

Por fim, ele faz uma soma imediata entre o valor armazenado no registrador x0 e 0 que finaliza o código.

2. Quais são os registradores utilizados no código?

São utilizados os registradores x0, x10, x11 e x12.

3. Quais são os conteúdos desses registradores ao final da execução do programa?

x0 = 0

x10 = 2

x11 = 4

x12 = 4

4. Adicione "prints" da tela do ambiente remoto ao PDF. Esses "prints" deverão mostrar os valores exibidos na interface após a execução de cada instrução (código de máquina, pc e demais registradores envolvidos).

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Machine Code	Basic Code	Original Code
0x00200513	addi x10 x0 2	addi x10, zero, 2
0x00400593	addi x11 x0 4	addi x11, zero, 4
0x00b50663	beq x10 x11 12	beq x10, x11, jump
0x00a50633	add x12 x10 x10	add x12, x10, x10
0x0080006f	jal x0 8	jal x0, fim
0x00b50633	add x12 x11 x11	jump: add x12, x11, x11
0x00000013	addi x0 x0 0	fin: addi x0, x0, 0

console output

Registers

Memory

zero	0x00000000
ra (x1)	0x00000000
sp (x2)	0x7fffffff
gp (x3)	0x10000000
tp (x4)	0x00000000
t0 (x5)	0x00000000
t1 (x6)	0x00000000
t2 (x7)	0x00000000
s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x00000000
a1 (x11)	0x00000000
a2 (x12)	0x00000000
a3 (x13)	0x00000000
a4 (x14)	0x00000000
a5 (x15)	0x00000000

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Machine Code	Basic Code	Original Code
0x00200513	addi x10 x0 2	addi x10, zero, 2
0x00400593	addi x11 x0 4	addi x11, zero, 4
0x00b50663	beq x10 x11 12	beq x10, x11, jump
0x00a50633	add x12 x10 x10	add x12, x10, x10
0x0080006f	jal x0 8	jal x0, fim
0x00b50633	add x12 x11 x11	jump: add x12, x11, x11
0x00000013	addi x0 x0 0	fin: addi x0, x0, 0

console output

Registers

Memory

zero	0x00000000
ra (x1)	0x00000000
sp (x2)	0x7fffffff
gp (x3)	0x10000000
tp (x4)	0x00000000
t0 (x5)	0x00000000
t1 (x6)	0x00000000
t2 (x7)	0x00000000
s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x00000002
a1 (x11)	0x00000000
a2 (x12)	0x00000000
a3 (x13)	0x00000000
a4 (x14)	0x00000000
a5 (x15)	0x00000000

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Machine Code	Basic Code	Original Code
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0x00400593	addi x11 x0 4	addi x11, zero, 4
0x00b50663	beq x10 x11 12	beq x10, x11, jump
0x00a50633	add x12 x10 x10	add x12, x10, x10
0x0080006f	jal x0 8	jal x0, fim
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console output

Registers

Memory

zero	0x00000000
ra (x1)	0x00000000
sp (x2)	0x7fffffff
gp (x3)	0x10000000
tp (x4)	0x00000000
t0 (x5)	0x00000000
t1 (x6)	0x00000000
t2 (x7)	0x00000000
s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x00000002
a1 (x11)	0x00000004
a2 (x12)	0x00000000
a3 (x13)	0x00000000
a4 (x14)	0x00000000
a5 (x15)	0x00000000

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0x00a50633	add x12 x10 x10	add x12, x10, x10
0x0080006f	jal x0 8	jal x0, fim
0x00b50633	add x12 x11 x11	jump: add x12, x11, x11
0x00000013	addi x0 x0 0	fin: addi x0, x0, 0

console output

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sp (x2)	0x7fffffff
gp (x3)	0x10000000
tp (x4)	0x00000000
t0 (x5)	0x00000000
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s0 (x8)	0x00000000
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a0 (x10)	0x00000002
a1 (x11)	0x00000004
a2 (x12)	0x00000000
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console output

Registers

Memory

	zero
ra (x1)	0x00000000
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gp (x3)	0x10000000
tp (x4)	0x00000000
t0 (x5)	0x00000000
t1 (x6)	0x00000000
t2 (x7)	0x00000000
s0 (x8)	0x00000000
s1 (x9)	0x00000000
a0 (x10)	0x00000002
a1 (x11)	0x00000004
a2 (x12)	0x00000004
a3 (x13)	0x00000000
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