Prova 2 – LAOC

Integrantes:

Eduardo Alves de Freitas

Matheus Dutra Cerbino

Introdução

O trabalho a seguir tem como objetivo realizar uma implementação de ciclo único do datapath de um processador MIPS 32 bits. A implementação é básica, não contemplando pipelining e apenas utilizando das instruções núcleo (core instructions) com o objetivo de aprofundar os conhecimentos no processamento de dados do processador.

Descrição

A implementação deste Datapath segue a do livro, partindo da implementação básica presente na página 271 da 5ª edição americana do livro Computer Organization and Design, a qual foi necessária adicionar novos circuitos para a realização de funções que não eram suportadas pelo Datapath mostrado no livro. Dentre estes circuitos, estão alguns multiplexadores e variáveis(fios) de controle.

Os seguintes Circuitos foram adicionados:

Multiplexador "extendUpPart" define como o immediate deve ser estendido, utilizando 1 para extensão com o bit de sinal ou 0 com zeros. O sinal de controle deste multiplexador é "extendType".

Multiplexador "selectRa" seleciona se o endereço do registrador de escrita será uma entrada manual do usuário (selectRaWire 0) ou o registrador "$ra" (selectRaWire 1), para pode ser utilizado na função jump and link(jal). O sinal de controle deste multiplexador é "selectRaWire".

Multiplexador "muxposbancoZero" seleciona se o immediate inserido será lido como a entrada do usuário (zeroImm 0) ou o valor zero (zeroImm 1). A variável de controle deste multiplexador é "zeroImm".

Foi adicionado uma nova função na ALU, com o valor de "ALUctl" igual a 11. Esta função desloca os 16 bits menos significativos para os 16 bits mais significativos.

Foi adicionado todos os controles necessários para realizar estas funções no modulo "ALUControl" e no modulo "Controle".

Testes Instruções

addi s1 s1 1000000000000011
Forma Binária: 00100010001100011000000000000011
Forma Hexadecimal: 0x22318003

1. O extendUpPart que controla qual será a extensão do immediate mostra que foi feita uma extensão de sinal, o que é o correto a se fazer, já que não se trata de uma operação unsigned.
2. O dado lido do banco de registradores é 0, já que os registradores são iniciados em 0, é lido o registradores correspondentes à instrução[25:21] que é 10001 (17).
3. O resultado da ALU principal, indicado por saidaALU retorna o campo immediate estendido , já que este valor foi somado a 0.
4. Como o controle RegWrite está em 1, e o controle MemtoReg está em 0, o valor obtido pela ALU é escrito no banco de registradores, o que pode ser confirmado avaliando o valor de writeData.

addiu s2 s2 1000100000000000
Forma Binária: 00100110010100101000100000000000
Forma Hexadecimal: 0x26528800

Edit:/DataPath/clk	St1	
Edit:/DataPath/rst	St0	
sim:/DataPath/data	0000000000000...	0000000000000000000000000001000
sim:/DataPath/endereco	0000000000000...	0000000000000000000000000000100
sim:/DataPath/instrucao	0010011001010...	00100110010100101000100000000000
sim:/DataPath/saidamuxposbanco	0000000000000...	0000000000000001000100000000000
sim:/DataPath/saidamuxposbancoZero	0000000000000...	0000000000000001000100000000000
sim:/DataPath/ReadData	xxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	0000000000000001000100000000000
sim:/DataPath/writeData	0000000000000...	0000000000000001000100000000000
sim:/DataPath/extendedShifted	1111111111111...	11111111111111100010000000000000
sim:/DataPath/ALUres	1111111111111...	11111111111111100010000000001000
sim:/DataPath/saidaSomadorPC	0000000000000...	0000000000000000000000000001000
sim:/DataPath/data1	0000000000000...	0000000000000000000000000000000
sim:/DataPath/data2	0000000000000...	0000000000000000000000000000000
sim:/DataPath/jumpAddress	0000100101001...	0000100101001010001000000000000
sim:/DataPath/BranchRes	0000000000000...	0000000000000000000000000001000
sim:/DataPath/enderecoJump	1001010010100...	100101001010001000000000000
sim:/DataPath/writeReg	10010	10010
sim:/DataPath/writeRegReal	10010	10010
sim:/DataPath/ALUControl	0010	0010
sim:/DataPath/zero	St0	

sim:/DataPath/extendUpPart	0000000000000000	0000000000000000
sim:/DataPath/RegDst	St0	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0011	0011
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St1	
sim:/DataPath/RegWrite	St1	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St0	
sim:/DataPath/bneSelect	St0	

add s3 s1 s2
Forma Binária: 00000010001100101001100000100000
Forma Hexadecimal: 0x02329820

Signal	Value	Waveform
Edit:/DataPath/clk	St1	
Edit:/DataPath/rst	St0	
sim:/DataPath/data	0000000000000...	00000000000000000000000000001100
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000001000
sim:/DataPath/instrucao	0000001000110...	00000010010100011010000000100000
sim:/DataPath/saidamuxposbanco	0000000000000...	00000000000000001000100000000000
sim:/DataPath/saidamuxposbancoZero	0000000000000...	00000000000000001000100000000000
sim:/DataPath/ReadData	xxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	00000000000000000100000000000011
sim:/DataPath/writeData	0000000000000...	00000000000000000100000000000011
sim:/DataPath/extendedShifted	1111111111111...	11111111111111100110000010000000
sim:/DataPath/ALUres	1111111111111...	11111111111111100110000010001100
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000001100
sim:/DataPath/data1	1111111111111...	11111111111111111000000000000011
sim:/DataPath/data2	0000000000000...	00000000000000001000100000000000
sim:/DataPath/jumpAddress	0000100011001...	00001000110010100110000010000000
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000001100
sim:/DataPath/enderecoJump	1000110010100...	10001100101001100000010000000
sim:/DataPath/writeReg	10011	10011
sim:/DataPath/writeRegReal	10011	10011
sim:/DataPath/ALUControl	0010	0010
sim:/DataPath/zero	St0	
sim:/DataPath/extendUpPart	1111111111111111	1111111111111111
sim:/DataPath/RegDst	St1	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0010	0010
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St0	
sim:/DataPath/RegWrite	St1	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St0	

sub s4 s2 s1
Forma Binária: 00000010010100011010000000100010
Forma Hexadecimal: 0x0251a022

Edit:/DataPath/clk	St1	
Edit:/DataPath/rst	St0	
sim:/DataPath/data	0000000000000...	00000000000000000000000000010000
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000001100
sim:/DataPath/instrucao	0000001001010...	00000010010100011010000000100010
sim:/DataPath/saidamuxposbanco	1111111111111...	11111111111111111000000000000011
sim:/DataPath/saidamuxposbancoZero	1111111111111...	11111111111111111000000000000011
sim:/DataPath/ReadData	xxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	00000000000000100000111111111101
sim:/DataPath/writeData	0000000000000...	00000000000000100000111111111101
sim:/DataPath/extendedShifted	1111111111111...	11111111111111101000000010001000
sim:/DataPath/ALUres	1111111111111...	11111111111111101000000100011000
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000010000
sim:/DataPath/data1	0000000000000...	00000000000000100010000000000000
sim:/DataPath/data2	1111111111111...	11111111111111111000000000000011
sim:/DataPath/jumpAddress	0000100101000...	00001001010001101010000000010001000
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000010000
sim:/DataPath/enderecoJump	1001010001101...	10010100011010000000010001000
sim:/DataPath/writeReg	10100	10100
sim:/DataPath/writeRegReal	10100	10100
sim:/DataPath/ALUControl	0110	0110
sim:/DataPath/zero	St0	
sim:/DataPath/extendUpPart	1111111111111111	1111111111111111
sim:/DataPath/RegDst	St1	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0010	0010
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St0	
sim:/DataPath/RegWrite	St1	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St0	

beq s4 s3 0x1

Forma Binária: 00010010100100110000000000000001

Forma Hexadecimal: 0x12930001

Edit:/DataPath/clk	St1
Edit:/DataPath/rst	St0
sim:/DataPath/data	0000000000000...	00000000000000000000000000010100
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000010000
sim:/DataPath/instrucao	0001001010010...	00010010100100110000000000000001
sim:/DataPath/saidamuxposbanco	0000000000000...	00000000000000000000100000000011
sim:/DataPath/saidamuxposbancoZero	0000000000000...	00000000000000000000100000000011
sim:/DataPath/ReadData	xxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	00000000000000001111111111110010
sim:/DataPath/writeData	0000000000000...	00000000000000001111111111110010
sim:/DataPath/extendedShifted	0000000000000...	00000000000000000000000000000100
sim:/DataPath/ALUres	0000000000000...	00000000000000000000000000011000
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000010100
sim:/DataPath/data1	0000000000000...	00000000000000100000111111111101
sim:/DataPath/data2	0000000000000...	00000000000000000000100000000011
sim:/DataPath/jumpAddress	0000101001001...	00001010010011000000000000000100
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000010100
sim:/DataPath/enderecoJump	1010010011000...	10100100110000000000000000100
sim:/DataPath/writeReg	10011	10011
sim:/DataPath/writeRegReal	10011	10011
sim:/DataPath/ALUControl	0110	0110
sim:/DataPath/zero	St0	

sim:/DataPath/extendUpPart	0000000000000000	0000000000000000
sim:/DataPath/RegDst	St0	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St1	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0001	0001
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St0	
sim:/DataPath/RegWrite	St0	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St0	

bne s4 s3 0x1
Forma Binária: 00010110100100110000000000000001
Forma Hexadecimal: 0x16930001

Signal	Value	Waveform
Edit:/DataPath/clk	St1	
Edit:/DataPath/rst	St0	
sim:/DataPath/data	0000000000000...	00000000000000000000000000011100
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000010100
sim:/DataPath/instrucao	000101101001 0...	00010110100100110000000000000001
sim:/DataPath/saidamuxposbanco	0000000000000...	00000000000000000001000000000011
sim:/DataPath/saidamuxposbancoZero	0000000000000...	00000000000000000001000000000011
sim:/DataPath/ReadData	xxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	00000000000000001111111111110010
sim:/DataPath/writeData	0000000000000...	00000000000000001111111111110010
sim:/DataPath/extendedShifted	0000000000000...	00000000000000000000000000000100
sim:/DataPath/ALUres	0000000000000...	00000000000000000000000000011100
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000011000
sim:/DataPath/data1	0000000000000...	00000000000000100000111111111101
sim:/DataPath/data2	0000000000000...	00000000000000000001000000000011
sim:/DataPath/jumpAddress	000010100100 1...	00001010010011000000000000000100
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000011100
sim:/DataPath/enderecoJump	10100100110000...	1010010011000000000000000100
sim:/DataPath/writeReg	10011	10011
sim:/DataPath/writeRegReal	10011	10011
sim:/DataPath/ALUControl	0110	0110
sim:/DataPath/zero	St0	

Signal	Value	Waveform
sim:/DataPath/extendUpPart	0000000000000000	0000000000000000
sim:/DataPath/RegDst	St0	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St1	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0001	0001
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St0	
sim:/DataPath/RegWrite	St0	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St1	

and s3 s1 s2
Forma Binária: 00000010001100101001100000100100
Forma Hexadecimal: 0x02329824

Edit:/DataPath/clk	St0	
Edit:/DataPath/rst	St1	
sim:/DataPath/data	0000000000000...	00000000000000000000000000000100
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000000000
sim:/DataPath/instrucao	0000001000110...	00000010001100101010000000100100
sim:/DataPath/saidamuxposbanco	0000000000000...	00000000000000000000000000000000
sim:/DataPath/saidamuxposbancoZero	0000000000000...	00000000000000000000000000000000
sim:/DataPath/ReadData	xxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	00000000000000000000000000000000
sim:/DataPath/writeData	0000000000000...	00000000000000000000000000000000
sim:/DataPath/extendedShifted	1111111111111...	11111111111111100110000010010000
sim:/DataPath/ALUres	1111111111111...	11111111111111100110000010010100
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000000100
sim:/DataPath/data1	0000000000000...	00000000000000000000000000000000
sim:/DataPath/data2	0000000000000...	00000000000000000000000000000000
sim:/DataPath/jumpAddress	0000100011001...	00001000110010100110000100010000
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000000100
sim:/DataPath/enderecoJump	1000110010100...	10001100101001100001000100000
sim:/DataPath/writeReg	10011	10011
sim:/DataPath/writeRegReal	10011	10011
sim:/DataPath/ALUControl	0000	0000
sim:/DataPath/zero	St1	

sim:/DataPath/extendUpPart	1111111111111111	1111111111111111
sim:/DataPath/RegDst	St1	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0010	0010
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St0	
sim:/DataPath/RegWrite	St1	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St0	

or s4 s1 s2
Forma Binária: 00000010001100101010000000100101
Forma Hexadecimal: 0x0232a025

Signal	Value
Edit:/DataPath/clk	St1
Edit:/DataPath/rst	St0
sim:/DataPath/data	0000000000000...	00000000000000000000000000100000
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000011100
sim:/DataPath/instrucao	0000001000110...	00000010001100101010000000100101
sim:/DataPath/saidamuxposbanco	0000000000000...	00000000000000001000100000000000
sim:/DataPath/saidamuxposbancoZero	0000000000000...	00000000000000001000100000000000
sim:/DataPath/ReadData	xxxxxxxxxxxx...	
sim:/DataPath/saidaALU	1111111111111...	11111111111111111000100000000011
sim:/DataPath/writeData	1111111111111...	11111111111111111000100000000011
sim:/DataPath/extendedShifted	1111111111111...	11111111111111101000000010010100
sim:/DataPath/ALUres	1111111111111...	11111111111111101000000010110100
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000100000
sim:/DataPath/data1	1111111111111...	11111111111111111000000000000011
sim:/DataPath/data2	0000000000000...	00000000000000001000100000000000
sim:/DataPath/jumpAddress	0000100011001...	00001000110010101000000010010100
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000100000
sim:/DataPath/enderecoJump	1000110010101...	10001100101010000000100101000
sim:/DataPath/writeReg	10100	10100
sim:/DataPath/writeRegReal	10100	10100
sim:/DataPath/ALUControl	0001	0001
sim:/DataPath/zero	St0	

Signal	Value
sim:/DataPath/extendUpPart	1111111111111111	1111111111111111
sim:/DataPath/RegDst	St1	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0010	0010
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St0	
sim:/DataPath/RegWrite	St1	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St0	

'nor s3 s2 s1
Forma Binária: 00000010001100101001100000100111
Forma Hexadecimal: 0x02329827

Edit:/DataPath/clk	St1	
Edit:/DataPath/rst	St0	
sim:/DataPath/data	0000000000000...	00000000000000000000000000100100
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000100100
sim:/DataPath/instrucao	0000001000110...	00000010001100101001100000100111
sim:/DataPath/saidamuxposbanco	0000000000000...	00000000000000001000100000000000
sim:/DataPath/saidamuxposbancoZero	0000000000000...	00000000000000001000100000000000
sim:/DataPath/ReadData	xxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	00000000000000000111011111111100
sim:/DataPath/writeData	0000000000000...	00000000000000000111011111111100
sim:/DataPath/extendedShifted	1111111111111...	11111111111111100110000010011100
sim:/DataPath/ALUres	1111111111111...	11111111111111100110000011000000
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000100100
sim:/DataPath/data1	1111111111111...	11111111111111111000000000000011
sim:/DataPath/data2	0000000000000...	00000000000000001000100000000000
sim:/DataPath/jumpAddress	0000100011001...	00001000110010100110000010011100
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000100100
sim:/DataPath/enderecoJump	1000110010100...	10001100101001100000100111100
sim:/DataPath/writeReg	10011	10011
sim:/DataPath/writeRegReal	10011	10011
sim:/DataPath/ALUControl	1100	1100
sim:/DataPath/zero	St0	

sim:/DataPath/extendUpPart	1111111111111111	1111111111111111
sim:/DataPath/RegDst	St1	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0010	0010
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St0	
sim:/DataPath/RegWrite	St1	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St0	

jump 0x4
Forma Binária: 00001000000000000000000000000100
Forma Hexadecimal: 0x08000004

Signal	Value	
Edit:/DataPath/clk	St1	
Edit:/DataPath/rst	St0	
sim:/DataPath/data	0000000000000...	00000000000000000000000000010000
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000100100
sim:/DataPath/instrucao	0000100000000...	00001000000000000000000000000100
sim:/DataPath/saidamuxposbanco	0000000000000...	00000000000000000000000000000000
sim:/DataPath/saidamuxposbancoZero	0000000000000...	00000000000000000000000000000000
sim:/DataPath/ReadData	xxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	00000000000000000000000000000000
sim:/DataPath/writeData	0000000000000...	00000000000000000000000000000000
sim:/DataPath/extendedShifted	0000000000000...	00000000000000000000000000010000
sim:/DataPath/ALUres	0000000000000...	00000000000000000000000000111000
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000101000
sim:/DataPath/data1	0000000000000...	00000000000000000000000000000000
sim:/DataPath/data2	0000000000000...	00000000000000000000000000000000
sim:/DataPath/jumpAddress	0000000000000...	00000000000000000000000000010000
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000101000
sim:/DataPath/enderecoJump	0000000000000...	0000000000000000000000010000
sim:/DataPath/writeReg	00000	00000
sim:/DataPath/writeRegReal	00000	00000
sim:/DataPath/ALUControl	0010	0010
sim:/DataPath/zero	St1	

Signal	Value	
sim:/DataPath/extendUpPart	0000000000000000	0000000000000000
sim:/DataPath/RegDst	St0	
sim:/DataPath/Jump	St1	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0000	0000
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St0	
sim:/DataPath/RegWrite	St0	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St0	

slti s1 s2 1111
Forma Binária: 00101010010100010000000000000111

Forma Hexadecimal: 0x2A51000F

Signal	Value	
Edit:/DataPath/clk	St1	
Edit:/DataPath/rst	St0	
sim:/DataPath/data	0000000000000...	0000000000000000000000000001000
sim:/DataPath/endereco	0000000000000...	0000000000000000000000000000100
sim:/DataPath/instrucao	0010101001010...	00101010010100010000000000001111
sim:/DataPath/saidamuxposbanco	0000000000000...	00000000000000000000000000001111
sim:/DataPath/saidamuxposbancoZero	0000000000000...	00000000000000000000000000001111
sim:/DataPath/ReadData	xxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	00000000000000000000000000001111
sim:/DataPath/writeData	0000000000000...	00000000000000000000000000001111
sim:/DataPath/extendedShifted	0000000000000...	00000000000000000000000000111100
sim:/DataPath/ALUres	0000000000000...	00000000000000000000000001000100
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000001000
sim:/DataPath/data1	0000000000000...	00000000000000000000000000000000
sim:/DataPath/data2	0000000000000...	00000000000000000000000000000000
sim:/DataPath/jumpAddress	0000100101000...	00001001010001000000000000111100
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000001000
sim:/DataPath/enderecoJump	1001010001000...	10010100010000000000000111100
sim:/DataPath/writeReg	10001	10001
sim:/DataPath/writeRegReal	10001	10001
sim:/DataPath/ALUControl	0010	0010
sim:/DataPath/zero	St0	

Signal	Value	
sim:/DataPath/extendUpPart	0000000000000000	0000000000000000
sim:/DataPath/RegDst	St0	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0011	0011
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St1	
sim:/DataPath/RegWrite	St1	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St0	

sltiu s1 s2 1111
Forma Binária: 00101110010100010000000000001111

Forma Hexadecimal: 0x2E51000F

andi s1 s2 1111
Forma Binária: 00110010010100010000000000001111

Forma Hexadecimal: 0x3251000F

Edit:/DataPath/clk	St1	
Edit:/DataPath/rst	St0	
sim:/DataPath/data	0000000000000...	00000000000000000000000000010000
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000001100
sim:/DataPath/instrucao	0011001001010...	00110010010100010000000000001111
sim:/DataPath/saidamuxposbanco	0000000000000...	00000000000000000000000000001111
sim:/DataPath/saidamuxposbancoZero	0000000000000...	00000000000000000000000000001111
sim:/DataPath/ReadData	xxxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	00000000000000000000000000000000
sim:/DataPath/writeData	0000000000000...	00000000000000000000000000000000
sim:/DataPath/extendedShifted	0000000000000...	00000000000000000000000000111100
sim:/DataPath/ALUres	0000000000000...	00000000000000000000000001001100
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000010000
sim:/DataPath/data1	0000000000000...	00000000000000000000000000000000
sim:/DataPath/data2	0000000000000...	00000000000000000000000000001111
sim:/DataPath/jumpAddress	0000100101000...	00001001010001000000000000111100
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000010000
sim:/DataPath/enderecoJump	1001010001000...	10010100010000000000000111100
sim:/DataPath/writeReg	10001	10001
sim:/DataPath/writeRegReal	10001	10001
sim:/DataPath/ALUControl	0000	0000
sim:/DataPath/zero	St1	

sim:/DataPath/extendUpPart	0000000000000000	0000000000000000
sim:/DataPath/RegDst	St0	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0101	0101
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St1	
sim:/DataPath/RegWrite	St1	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St0	
sim:/DataPath/bneSelect	St0	

ori s1 s2 1111
Forma Binária: 00110110010100010000000000001111

Forma Hexadecimal: 0x3651000F

lui s1 0xff
Forma Binária: 0011110000010001000000011111111

Forma Hexadecimal: 0x3C1100FF

Signal	Value	Waveform
Edit:/DataPath/clk	St1	
Edit:/DataPath/rst	St0	
sim:/DataPath/data	0000000000000...	00000000000000000000000000011000
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000010100
sim:/DataPath/instrucao	0011110000010...	00111100000100010000000011111111
sim:/DataPath/saidamuxposbanco	0000000000000...	00000000000000000000000011111111
sim:/DataPath/saidamuxposbancoZero	0000000000000...	00000000000000000000000011111111
sim:/DataPath/ReadData	xxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000011111...	00000000111111110000000000000000
sim:/DataPath/writeData	0000000011111...	00000000111111110000000000000000
sim:/DataPath/extendedShifted	0000000000000...	00000000000000000000001111111100
sim:/DataPath/ALUres	0000000000000...	00000000000000000000010000010100
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000011000
sim:/DataPath/data1	0000000000000...	00000000000000000000000000000000
sim:/DataPath/data2	0000000000000...	00000000000000000000000000001111
sim:/DataPath/jumpAddress	0000000001000...	00000000010001000000001111111100
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000011000
sim:/DataPath/enderecoJump	0000010001000...	00000100010000000011111111100
sim:/DataPath/writeReg	10001	10001
sim:/DataPath/writeRegReal	10001	10001
sim:/DataPath/ALUControl	1011	1011
sim:/DataPath/zero	St0	

Signal	Value	Waveform
sim:/DataPath/extendUpPart	0000000000000000	0000000000000000
sim:/DataPath/RegDst	St0	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0111	0111
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St1	
sim:/DataPath/RegWrite	St1	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St0	

sw s1 0xf(s2)
Forma Binária: 10101110010100010000000000001111

Forma Hexadecimal: 0xAE51000F

Edit:/DataPath/clk	St1	
Edit:/DataPath/rst	St0	
sim:/DataPath/data	0000000000000...	00000000000000000000000000011100
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000011000
sim:/DataPath/instrucao	1010111001010...	10101110010100010000000000001111
sim:/DataPath/saidamuxposbanco	0000000000000...	00000000000000000000000000001111
sim:/DataPath/saidamuxposbancoZero	0000000000000...	00000000000000000000000000001111
sim:/DataPath/ReadData	xxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	00000000000000000000000000001111
sim:/DataPath/writeData	0000000000000...	00000000000000000000000000001111
sim:/DataPath/extendedShifted	0000000000000...	00000000000000000000000000111100
sim:/DataPath/ALUres	0000000000000...	00000000000000000000000000101000
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000011100
sim:/DataPath/data1	0000000000000...	00000000000000000000000000000000
sim:/DataPath/data2	0000000011111...	00000000111111110000000000000000
sim:/DataPath/jumpAddress	0000100101000...	00001001010001000000000000111100
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000011100
sim:/DataPath/enderecoJump	1001010001000...	10010100010000000000000111100
sim:/DataPath/writeReg	10001	10001
sim:/DataPath/writeRegReal	10001	10001
sim:/DataPath/ALUControl	0010	0010
sim:/DataPath/zero	St0	

sim:/DataPath/extendUpPart	0000000000000000	0000000000000000
sim:/DataPath/RegDst	St0	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0000	0000
sim:/DataPath/MemWrite	St1	
sim:/DataPath/ALUSrc	St1	
sim:/DataPath/RegWrite	St0	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St0	

lw s1 0xf(s2)
Forma Binária: 10001110010100010000000000001111

Forma Hexadecimal: 0x8E51000F

Signal	Value	
Edit:/DataPath/clk	St1	
Edit:/DataPath/rst	St0	
sim:/DataPath/data	0000000000000...	00000000000000000000000000100000
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000011100
sim:/DataPath/instrucao	1000111001010...	10001110010100010000000000001111
sim:/DataPath/saidamuxposbanco	0000000000000...	00000000000000000000000000001111
sim:/DataPath/saidamuxposbancoZero	0000000000000...	00000000000000000000000000001111
sim:/DataPath/ReadData	xxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	00000000000000000000000000001111
sim:/DataPath/writeData	xxxxxxxxxxxx...	
sim:/DataPath/extendedShifted	0000000000000...	00000000000000000000000000111100
sim:/DataPath/ALUres	0000000000000...	00000000000000000000000010011100
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000100000
sim:/DataPath/data1	0000000000000...	00000000000000000000000000000000
sim:/DataPath/data2	0000000011111...	00000000111111110000000000000000
sim:/DataPath/jumpAddress	0000100101000...	00001001010001000000000000111100
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000100000
sim:/DataPath/enderecoJump	1001010001000...	10010100010000000000000111100
sim:/DataPath/writeReg	10001	10001
sim:/DataPath/writeRegReal	10001	10001
sim:/DataPath/ALUControl	0010	0010
sim:/DataPath/zero	St0	

Signal	Value	
sim:/DataPath/extendUpPart	0000000000000000	0000000000000000
sim:/DataPath/RegDst	St0	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St1	
sim:/DataPath/MemtoReg	St1	
sim:/DataPath/ALUOp	0000	0000
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St1	
sim:/DataPath/RegWrite	St1	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St0	

jal 0xf
Forma Binária: 00001100000000000000000000001111

Forma Hexadecimal: 0x0C00000F

Edit:/DataPath/clk	St1	
Edit:/DataPath/rst	St0	
sim:/DataPath/data	0000000000000...	0000000000000000000000000111100
sim:/DataPath/endereco	0000000000000...	0000000000000000000000000100000
sim:/DataPath/instrucao	0000110000000...	0000110000000000000000000001111
sim:/DataPath/saidamuxposbanco	0000000000000...	0000000000000000000000000001111
sim:/DataPath/saidamuxposbancoZero	0000000000000...	0000000000000000000000000000000
sim:/DataPath/ReadData	0000000011111...	0000000011111111000000000000000
sim:/DataPath/saidaALU	0000000000000...	0000000000000000000000000000000
sim:/DataPath/writeData	0000000000000...	0000000000000000000000000000000
sim:/DataPath/extendedShifted	0000000000000...	0000000000000000000000000111100
sim:/DataPath/ALUres	0000000000000...	0000000000000000000000001100000
sim:/DataPath/saidaSomadorPC	0000000000000...	0000000000000000000000000100100
sim:/DataPath/data1	0000000000000...	0000000000000000000000000000000
sim:/DataPath/data2	0000000000000...	0000000000000000000000000000000
sim:/DataPath/jumpAddress	0000000000000...	0000000000000000000000000111100
sim:/DataPath/BranchRes	0000000000000...	0000000000000000000000000100100
sim:/DataPath/enderecoJump	0000000000000...	00000000000000000000000111100
sim:/DataPath/writeReg	00000	00000
sim:/DataPath/writeRegReal	00001	00001
sim:/DataPath/ALUControl	0010	0010
sim:/DataPath/zero	St1	

sim:/DataPath/extendUpPart	0000000000000000	0000000000000000
sim:/DataPath/RegDst	St0	
sim:/DataPath/Jump	St1	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0011	0011
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St1	
sim:/DataPath/RegWrite	St1	
sim:/DataPath/selectRaWire	St1	
sim:/DataPath/zeroImm	St1	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St0	

addu s3 s2 s1
Forma Binária: 00000010010100011001100000100001

Forma Hexadecimal: 0x02519821

Signal	Value
Edit:/DataPath/clk	St1
Edit:/DataPath/rst	St0
sim:/DataPath/data	0000000000000...	00000000000000000000000000001100
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000001000
sim:/DataPath/instrucao	0000001000110...	00000010001100101001100000100001
sim:/DataPath/saidamuxposbanco	1111111111111...	11111111111111111000100000000000
sim:/DataPath/saidamuxposbanc...	1111111111111...	11111111111111111000100000000000
sim:/DataPath/ReadData	xxxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	00000000000000000000000000000000
sim:/DataPath/writeData	0000000000000...	00000000000000000000000000000000
sim:/DataPath/extendedShifted	1111111111111...	11111111111111100110000010000100
sim:/DataPath/ALUres	1111111111111...	11111111111111100110000010010000
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000001100
sim:/DataPath/data1	1111111111111...	11111111111111111000000000000011
sim:/DataPath/data2	1111111111111...	11111111111111111000100000000000
sim:/DataPath/jumpAddress	0000100011001...	00001000110010100110000010000100
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000001100
sim:/DataPath/enderecoJump	1000110010100...	100011001010011000001000100
sim:/DataPath/writeReg	10011	10011
sim:/DataPath/writeRegReal	10011	10011
sim:/DataPath/ALUControl	1111	1111
sim:/DataPath/zero	St1

Signal	Value
sim:/DataPath/extendUpPart	1111111111111111	1111111111111111
sim:/DataPath/RegDst	St1
sim:/DataPath/Jump	St0
sim:/DataPath/Branch	St0
sim:/DataPath/MemRead	St0
sim:/DataPath/MemtoReg	St0
sim:/DataPath/ALUOp	0010	0010
sim:/DataPath/MemWrite	St0
sim:/DataPath/ALUSrc	St0
sim:/DataPath/RegWrite	St1
sim:/DataPath/selectRaWire	St0
sim:/DataPath/zeroImm	St0
sim:/DataPath/extendType	St1
sim:/DataPath/bneSelect	St0

subu s4 s2 s1

Forma Binária: 00000010010100011010000000100011
Forma Hexadecimal: 0x0251A023

sim:/DataPath/extendUpPart	1111111111111111
sim:/DataPath/RegDst	St1
sim:/DataPath/Jump	St0
sim:/DataPath/Branch	St0
sim:/DataPath/MemRead	St0
sim:/DataPath/MemtoReg	St0
sim:/DataPath/ALUOp	0010
sim:/DataPath/MemWrite	St0
sim:/DataPath/ALUSrc	St0
sim:/DataPath/RegWrite	St1
sim:/DataPath/selectRaWire	St0
sim:/DataPath/zeroImm	St0
sim:/DataPath/extendType	St1
sim:/DataPath/bneSelect	St0

slt s5 s3 s1
Forma Binária: 00000010011100011010100000101010
Forma Hexadecimal: 0x0271A82A

Signal	Value	Waveform
Edit:/DataPath/clk	St1	
Edit:/DataPath/rst	St0	
sim:/DataPath/data	0000000000000...	00000000000000000000000000010100
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000010000
sim:/DataPath/instrucao	0000001001110...	00000010011100011010100010101010
sim:/DataPath/saidamuxposbanco	1111111111111...	11111111111111111000000000000011
sim:/DataPath/saidamuxposbanc...	1111111111111...	11111111111111111000000000000011
sim:/DataPath/ReadData	xxxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	00000000000000000000000000000001
sim:/DataPath/writeData	0000000000000...	00000000000000000000000000000001
sim:/DataPath/extendedShifted	1111111111111...	11111111111111101010000010101000
sim:/DataPath/ALUres	1111111111111...	11111111111111101010000010111100
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000010100
sim:/DataPath/data1	0000000000000...	00000000000000000000000000000000
sim:/DataPath/data2	1111111111111...	11111111111111111000000000000011
sim:/DataPath/jumpAddress	0000100111000...	00001001110001101010000010101000
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000010100
sim:/DataPath/enderecoJump	1001110001101...	10011100011010100000101010000
sim:/DataPath/writeReg	10101	10101
sim:/DataPath/writeRegReal	10101	10101
sim:/DataPath/ALUControl	0111	0111
sim:/DataPath/zero	St0	

Signal	Value	Waveform
sim:/DataPath/extendUpPart	1111111111111111	1111111111111111
sim:/DataPath/RegDst	St1	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0010	0010
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St0	
sim:/DataPath/RegWrite	St1	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St0	

sltu s6 s3 s1

Forma Binária: 00000010011100011011000000101011

Forma Hexadecimal: 0x0271B02B

Signal	Value	Waveform
Edit:/DataPath/clk	St1	
Edit:/DataPath/rst	St0	
sim:/DataPath/data	0000000000000...	00000000000000000000000000011000
sim:/DataPath/endereco	0000000000000...	00000000000000000000000000010100
sim:/DataPath/instrucao	0000001001110...	00000010011100011011000000101011
sim:/DataPath/saidamuxposbanco	1111111111111...	11111111111111111000000000000011
sim:/DataPath/saidamuxposbanc...	1111111111111...	11111111111111111000000000000011
sim:/DataPath/ReadData	xxxxxxxxxxxxx...	
sim:/DataPath/saidaALU	0000000000000...	00000000000000000000000000000000
sim:/DataPath/writeData	0000000000000...	00000000000000000000000000000000
sim:/DataPath/extendedShifted	1111111111111...	11111111111111101100000010101100
sim:/DataPath/ALUres	1111111111111...	11111111111111101100000011000100
sim:/DataPath/saidaSomadorPC	0000000000000...	00000000000000000000000000011000
sim:/DataPath/data1	0000000000000...	00000000000000000000000000000000
sim:/DataPath/data2	1111111111111...	11111111111111111000000000000011
sim:/DataPath/jumpAddress	0000100111000...	00001001110001101100000010101100
sim:/DataPath/BranchRes	0000000000000...	00000000000000000000000000011000
sim:/DataPath/enderecoJump	1001110001101...	10011100011011000000101011001
sim:/DataPath/writeReg	10110	10110
sim:/DataPath/writeRegReal	10110	10110
sim:/DataPath/ALUControl	1111	1111
sim:/DataPath/zero	St1	

sim:/DataPath/extendUpPart	1111111111111111	1111111111111111
sim:/DataPath/RegDst	St1	
sim:/DataPath/Jump	St0	
sim:/DataPath/Branch	St0	
sim:/DataPath/MemRead	St0	
sim:/DataPath/MemtoReg	St0	
sim:/DataPath/ALUOp	0010	0010
sim:/DataPath/MemWrite	St0	
sim:/DataPath/ALUSrc	St0	
sim:/DataPath/RegWrite	St1	
sim:/DataPath/selectRaWire	St0	
sim:/DataPath/zeroImm	St0	
sim:/DataPath/extendType	St1	
sim:/DataPath/bneSelect	St0	