

Description of Control Signals in our Single Cycle Implementation of the RISC-V 32I ISA

Signal Name	# of bits	value	action
PCMux.CTL	2	0	Next PC = output of ALU
		1	Next PC = result of branch instruction
		2	Next PC = PC + (targ20 << 1)
		3	Next PC = PC + 4
regFile.WE	1	0	Register file not written
		1	Register file written: rd will be updated with value of the write input
regInputMux.CTL	3	0	Write Input = ALU output
		1	Write Input = 4-bytes from Data Memory
		2	Write Input = sext 2-bytes from data memory
		3	Write Input = sext 1 byte from data memory
		4	Write Input = PC + value based on PCAddMux.CTL
PCAddMux.CTL	1	0	Send 4 + PC towards registers
		1	Send (I[31:12] << 12) + PC towards regs
DATA.WE	4	0	Data memory not written
		1	[0001] write the least significant byte from source register to data memory
		3	[0011] write the two lower bytes from source register to data memory
		15	[1111] write all four bytes of the source register to data memory
ALUInputMux.CTL	1	0	Second input to ALU is rs2
		1	Second input to ALU is I[31:0]
ALU.CTL	6		
Arithmetic Ops (I)		0	$C = A + \text{se}(B[31:20])$
		1	$C = A < \text{se}(B[31:20]) ? 1 : 0$
		2	$C = A < \text{unsigned se}(B[31:20]) ? 1 : 0$
		3	$C = A \wedge \text{se}(B[31:20])$
		4	$C = A \mid \text{se}(B[31:20])$

	5	$C = A \& \text{se}(B[31:20])$
	6	$C = A \ll \text{se}(B[24:20])$
	7	$C = A \gg \text{se}(B[24:20])$
	8	$C = A \ggg \text{se}(B[24:20])$
Arithmetic Ops (R)	9	$C = A + B$
	10	$C = A - B$
	11	$C = A \ll B[4:0]$
	12	$C = A < \text{signed } B ? 1 : 0$
	13	$C = A < \text{unsigned } B ? 1 : 0$
	14	$C = A \wedge B$
	15	$C = A \gg B[4:0]$
	16	$C = A \ggg B[4:0]$
	17	$C = A B$
	18	$C = A \& B$
Comparator Ops	19	$C = A == B ? 1 : 0$
	20	$C = A != B ? 1 : 0$
	21	$C = A < \text{signed } B ? 1 : 0$
	22	$C = A \geq \text{signed } B ? 1 : 0$
	23	$C = A < \text{unsigned } B ? 1 : 0$
	24	$C = A \geq \text{unsigned } B ? 1 : 0$
Multiplication Ops	25	$C = (A * B)[31:0]$
	26	$C = (\text{signed}(A) * \text{signed}(B))[63:32]$
	27	$C = (\text{signed}(A) * \text{unsign}(B))[63:32]$
	28	$C = (\text{unsign}(A) * \text{unsign}(B))[63:32]$
Division Ops	29	$C = A / \text{signed } B$
	30	$C = A / \text{unsign } B$
	31	$C = A \% \text{signed } B$
	32	$C = A \% \text{unsign } B$
Misc	33	$C = B[31:12] \ll 12$
	34	$C = A + \text{se}(B[31:20]) \& \sim 0x1$
	35	$C = (B[31]B[19:12]B[20]B[30:21]) \ll 1$
	36	$C = A + \text{se}(B[31:25]B[11:7])$