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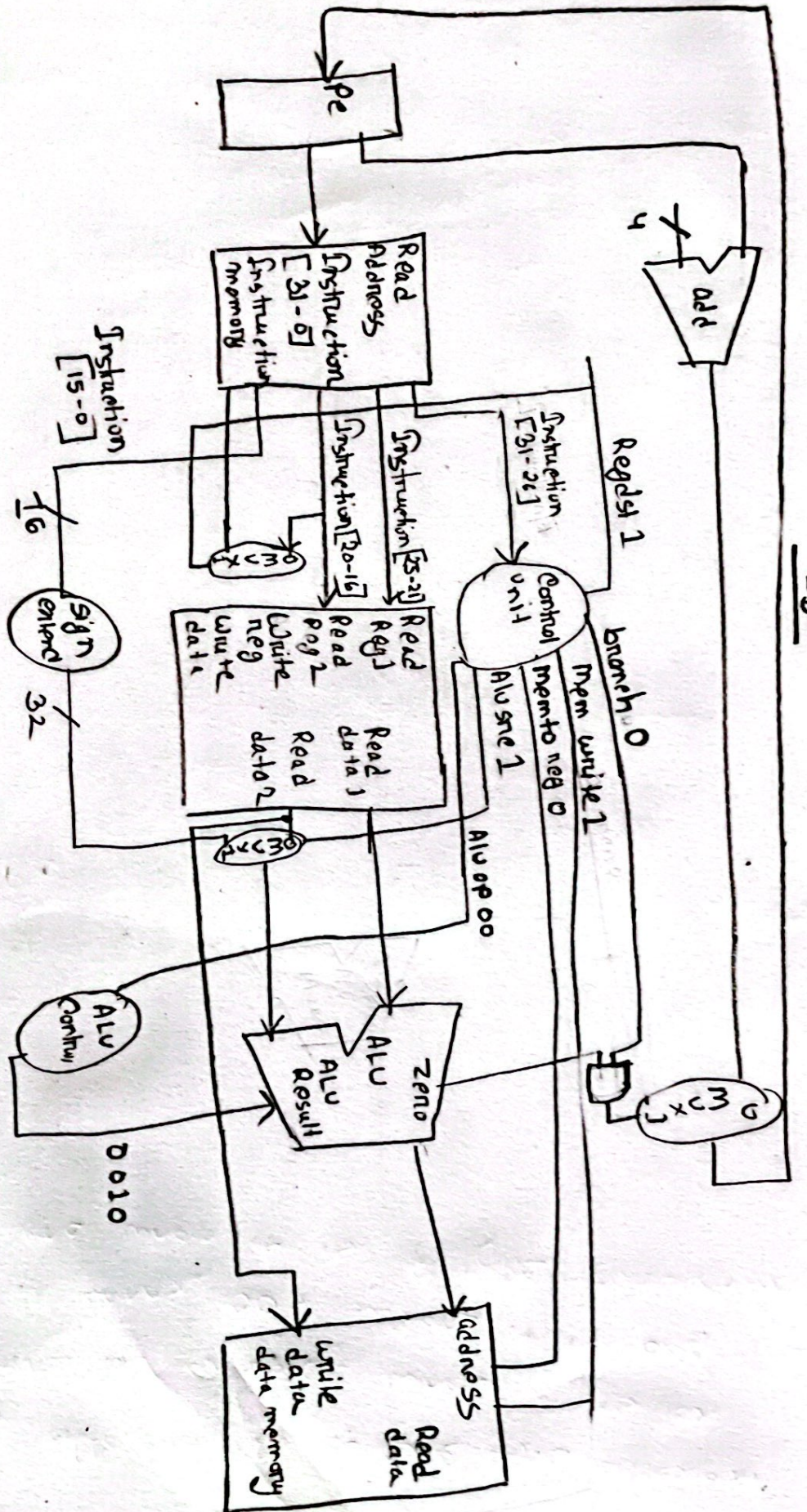Section: 09
Course: CSE 340

1a

Control unit sends different Alu op code for different types of instruction. For example, when it is lw, sw instruction it sends 00, when it is beq it sends 01 and when it is R type instructions it send 10.

SW $s3, 32 ($s2)

opcode	rs	rt	Address/offset
xxxxxx	$s3	$s2	32
31-26	25-21	20-16	15-0

PC

4

Add

Read Address
Instruction [31-0]
Instruction memory

Instruction [15-0]

Instruction [25-21]

Instruction [20-16]

Instruction [31-26]

Reg dst 1

Control unit

branch 0
Mem to reg 0
Mem write 1
Alu src 1
Alu op 00

Read Reg1
Read Reg2
Write reg
Write data

Read data1
Read data2

Sign extend
32

16

Mux30

Mux30

ALU
ALU Result
Zero

ALU Control

0010

Mux3G

10

Address
Read data
Write data
data memory

Pipeline stages

	cc1	cc2	cc3	cc4	cc5	cc6	cc7	cc8	cc9
1. Sw R1, 0(R2)	IF	ID	EX	ME	WB				
2 add R4, R2, R5		IF	ID	EX	ME	WB			
3. on R6 (R4, R7			IF	ID	EX	ME	WB		
4. and R8, R1, R4				IF	ID	EX	ME	WB	

Hazard removal using Stall and forwarding

	cc1	cc2	cc3	cc4	cc5	cc6	cc7	cc8
1 sw R1, 0(R2)	IF	ID	EX	ME	WB			
2. add R4, R1, R5		IF	ID	EX	ME	WB		
3. OR R6, R4, R7			IF	ID	EX	ME	WB	
4. and R8, R1, R6				IF	ID	EX	ME	WB