BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE , PILANI K. K. BIRLA Goa Campus
First Semester 2020 - 2021
CS F342 Computer Architecture
Lab - 4

Implement **single cycle datapath** for the following instructions.

ALU Control Unit : -

Input : ALUOp , Instruction[5:0]
Output : Operation

ALUOp	Instruction	Operation
00	XXXXXX	0010
X1	XXXXXX	0110
1X	XX0000	0010
	XX0010	0110
	XX0100	0000
	XX0101	0001
	XX1010	0111

Control Circuit : -

Input : Instruction[31-26]
Output : RegDst , Branch , MemRead , MemtoReg , ALUOp , MemWrite , ALUSrc , RegWrite , Jump

Instructions	RegDst	Branch	MemRead	MemToReg	ALUOp	MemWrite	ALUSrc	RegWrite	Jump
000000	1	0	0	0	10	0	0	1	0
001000	0	0	0	0	00	0	1	1	0
100011	0	0	1	1	00	0	1	1	0
101011	x	0	0	x	00	1	1	0	0
000100	x	1	0	x	01	0	0	0	0
000010	x	0	x	x	xx	x	x	x	1

ALU :-

Input : ALUIn1 , ALUIn2
Output : Zero , ALUout

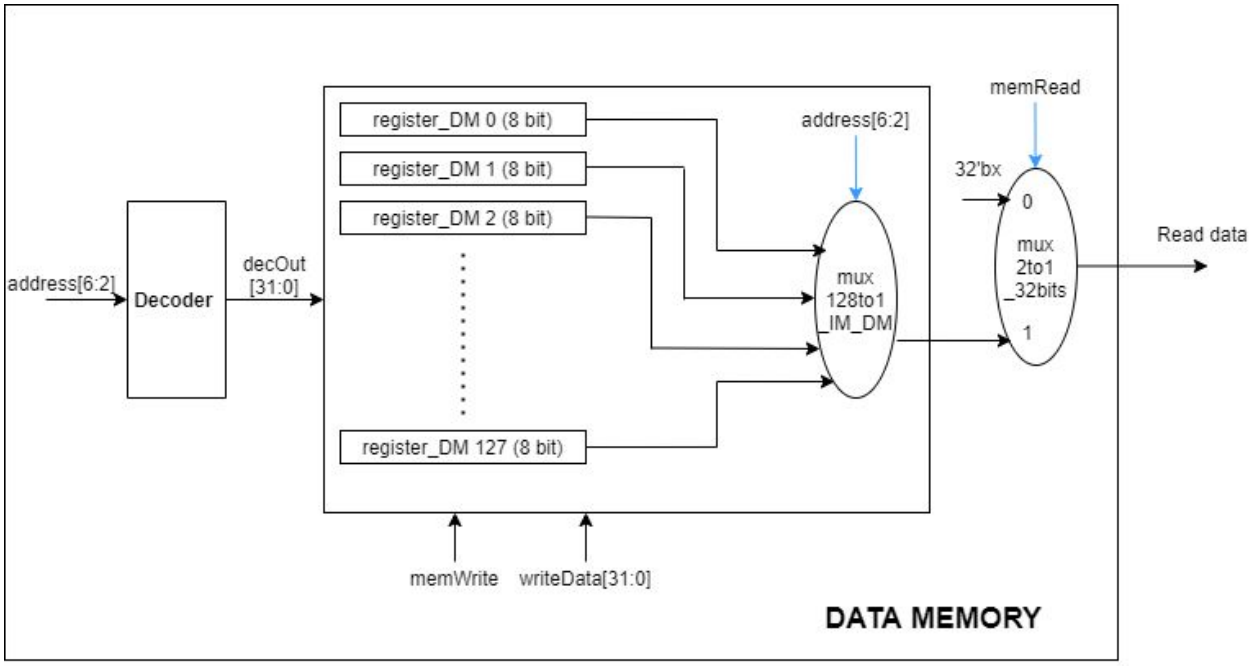
Instruction	ALUout
0000	ALUIn1 & ALUIn2
0001	ALUIn1 | ALUIn2
0010	ALUIn1 + ALUIn2
0110	ALUIn1 - ALUIn2
0111	If(ALUIn1 < ALUIn2) then 32'd1
	If(ALUIn1 > ALUIn2) then 32'd0
1100	~(ALUIn1 | ALUIn2)

ALUOut	Zero
32'b0	1
!= 32'b0	0

Data Memory :-

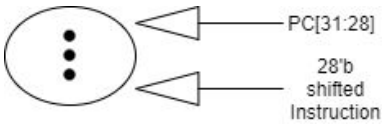
Input : Address[6:2] , Write Data ,memWrite , memRead, clk , reset
Output : Read Data

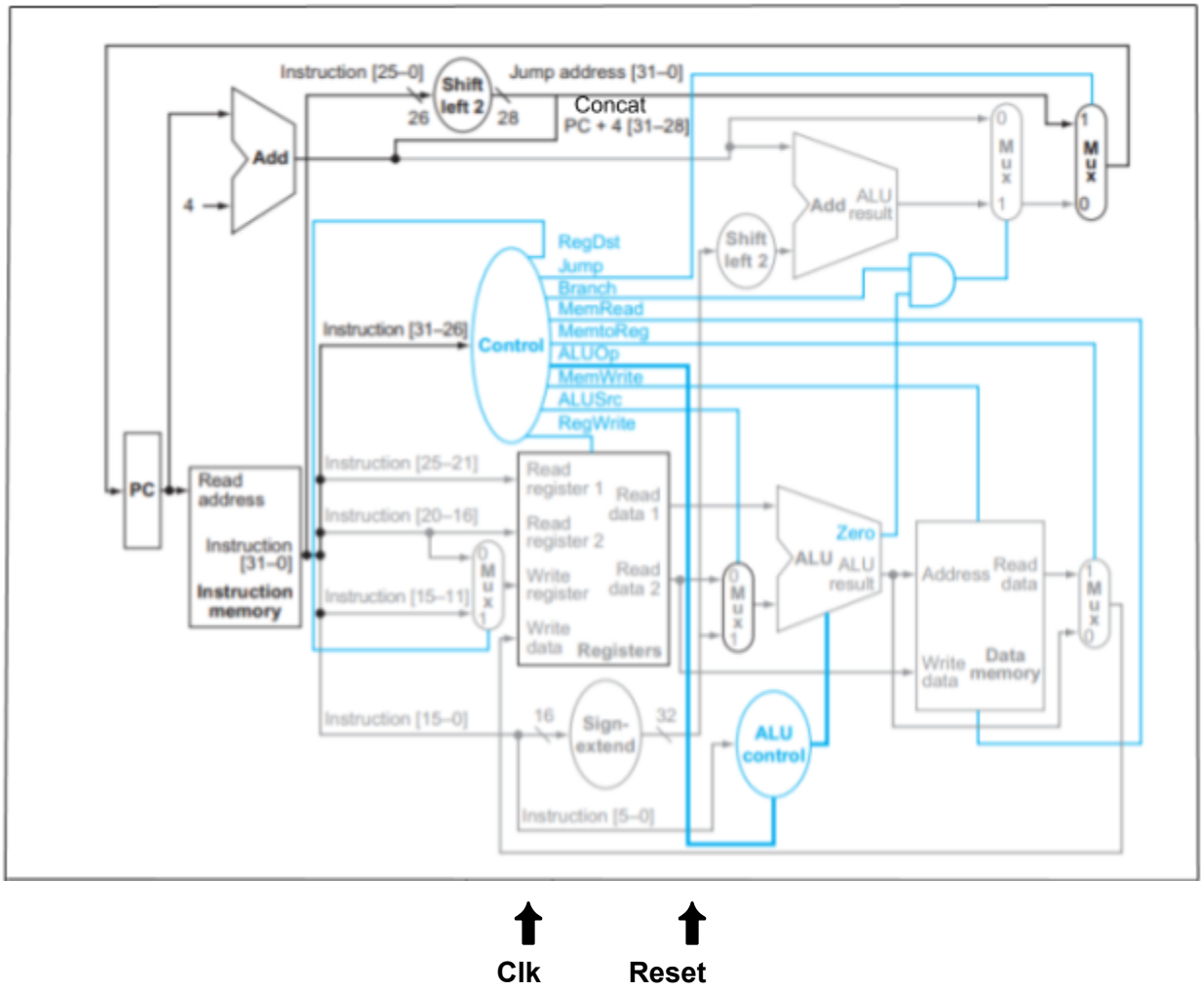
Data Memory circuit diagram :-



Single cycle datapath circuit diagram(Circuit diagram) :-

Note:- The [31:28] bits of PC+4 are being concatenated with the left shifted 28 bits of the Instruction. The zoomed in diagram is as follows:

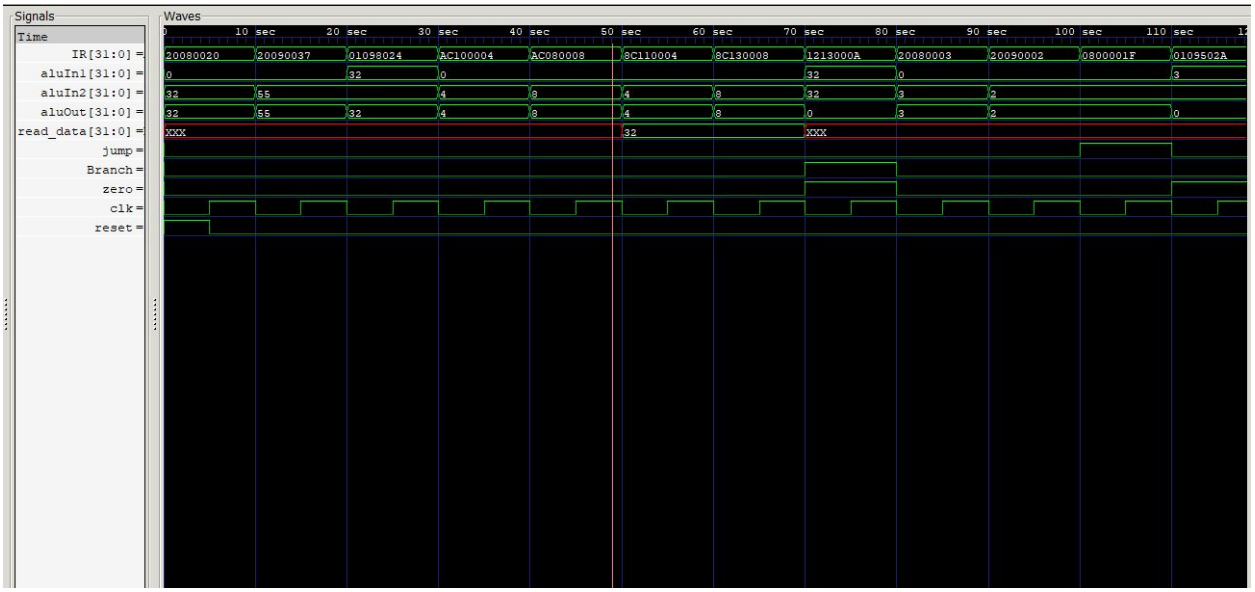




Clk **Reset**

Expected Outcome (Expected Outcome Link):-

1. Convert IR[31:0] to hexadecimal base for comparison.
2. Rest all are on decimal base.



Marking Scheme:

2 Marks - IR[31:0]
1 Mark - aluIn1 , aluIn2 , aluOut
1 Mark - read_data

Submission Method:

1. Save your singleCycle.v source file as **<Your ID>_Lab4.v**
   NOTE: Change yourID to your 13 digit BITS ID in the testbench
2. Save the vcd dump file generated as **<Your ID>_Lab4.vcd (this will already be called <Your ID>_Lab4.vcd since you have changed it in the testbench)**
3. Save your GTKWave output as **<Your ID>_Lab4.gtkw** using the 'Save As' option in File->Write

Create a **zip file** containing the above 3 files and submit it on Quanta. **Do not create archives in other formats (rar, tar.gz etc)**.
Once uploaded on Quanta, remember to **submit for grading**. **Do not leave it as a draft.**

NOTE: In case you are using a case statement with a don't care, use casex instead of case. For example casex xx000 instead of case xx000.