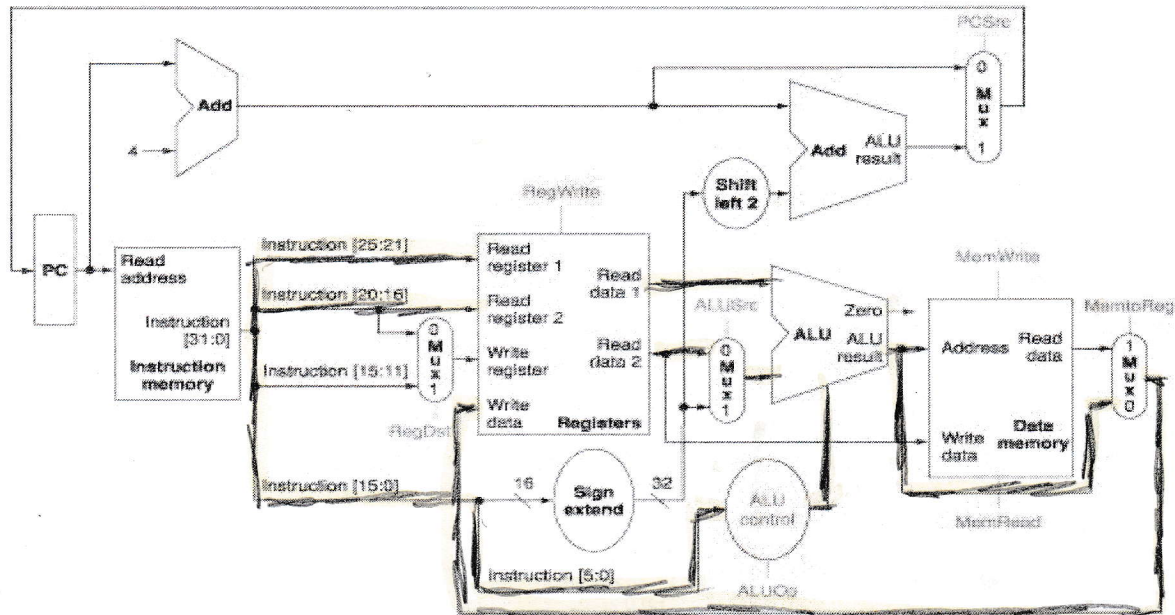Problem 1 (5 points).
The figure below is a datapath we constructed. We'd execute an instruction or R20, R22, R21on that datapath, please highlight the critical datapath. Note: A critical datapath refers to the meaningful operations on the datapath for that instruction, i.e. do not highlight those useless operations for that instruction.

Problem 2 (5 points).
Same as Problem 1. Now we'd execute an instruction sw R20, 0x0004 (R22) on that datapath, please highlight the critical datapath.
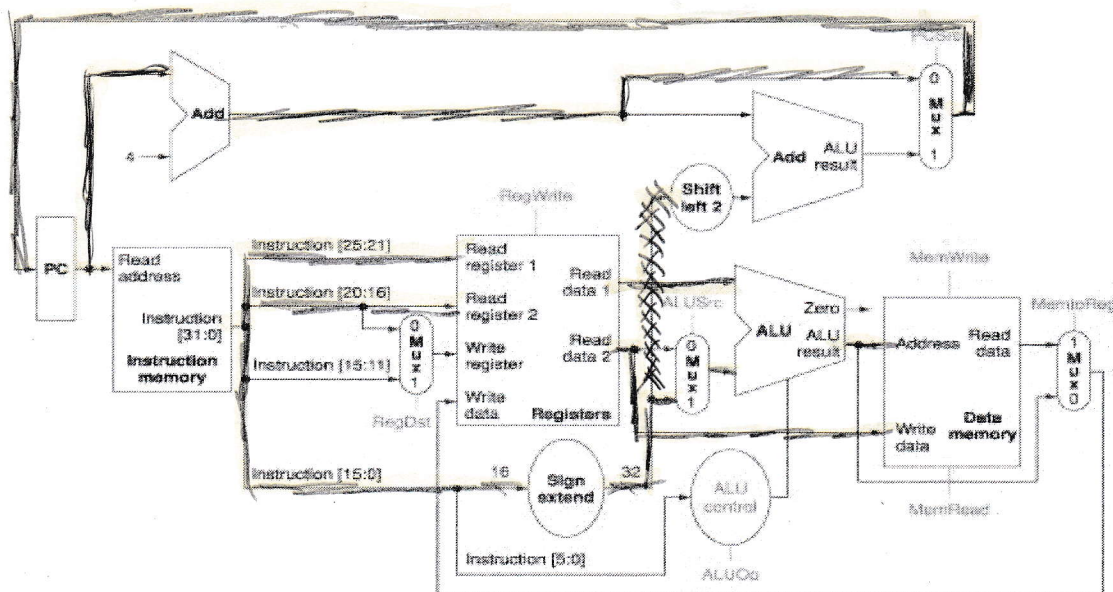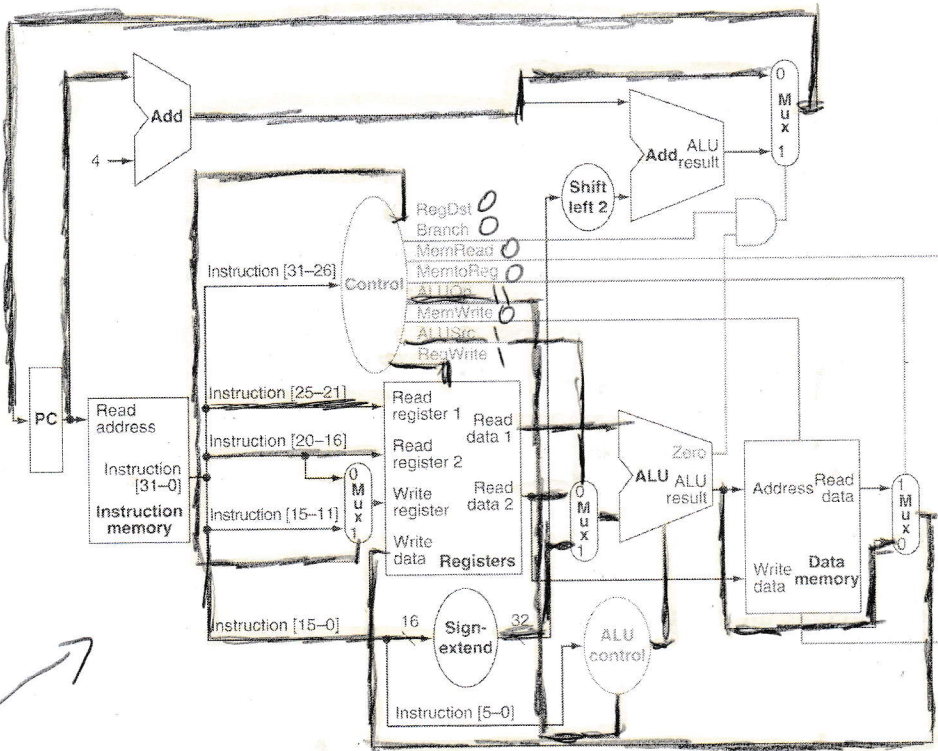

* After sign extend, data path goes to mux 1, not shift.

Problem 3 (6 points)
Given the following implementation scheme for a subset of MIPS instructions. Please determine the control signal values for each of the following instructions:

(1) lw R20, 0x0020 (R22)
(2) beq R20, R22, 0x0020

	RegDst	Branch	MemRead	MemToReg	ALUOp	MemWrite	ALUSrc	RegWrite
lw	0	0	1	1	0 0	0	1	1
beq	X	1	0	X	0 1	0	0	0

Problem 4 (3 points)
We'd include addi instruction in the above implementation scheme,

(1) please check the figure to see if any changes on datapath (e.g. adding a new connection, an extra Mux, etc.) or control unit (e.g. adding a new control signal) needed. If yes, please mark the changes on the figure. If none, just say so. NONE
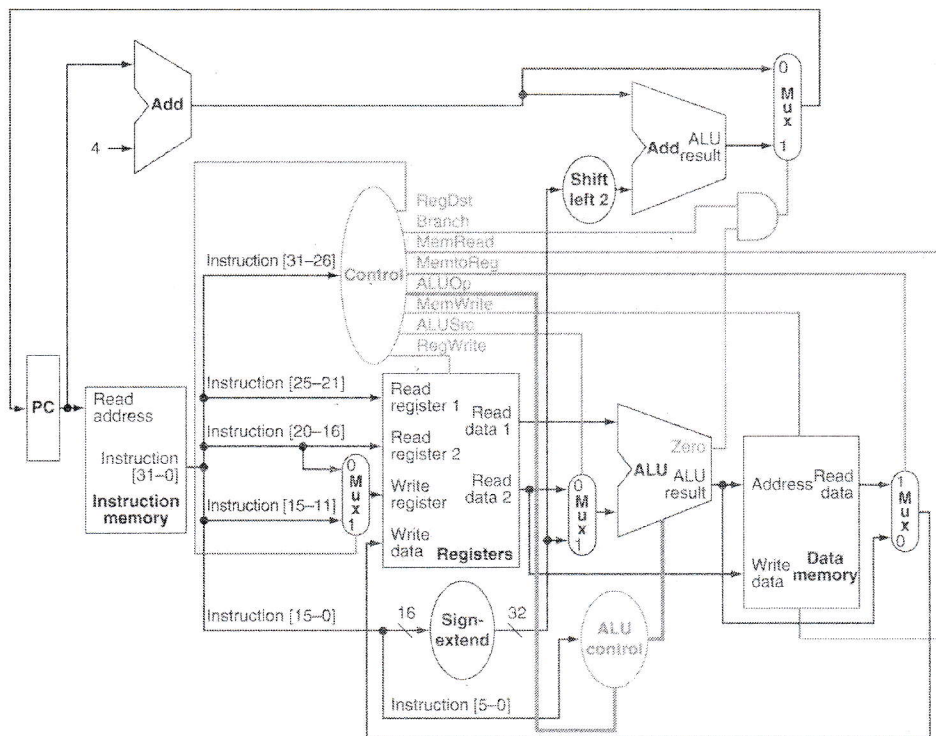
(2) Highlight the critical path of addi on the (updated, if needed) figure.

(3) Write the values of control signals on the figure next to each name of the control signals, e.g. MemWrite (0) indicating for this instruction the value of MemWrite is 0.

	RegDst	Branch	MemRead	MemToReg	ALUOp	MemWrite	ALUSrc	RegWrite
addi	0	0	0	0	11	0	1	1

Problem 5 (1 point) How do we implement the bne instruction? Brainstorm and modify the datapath and/or control below to show your implementation.
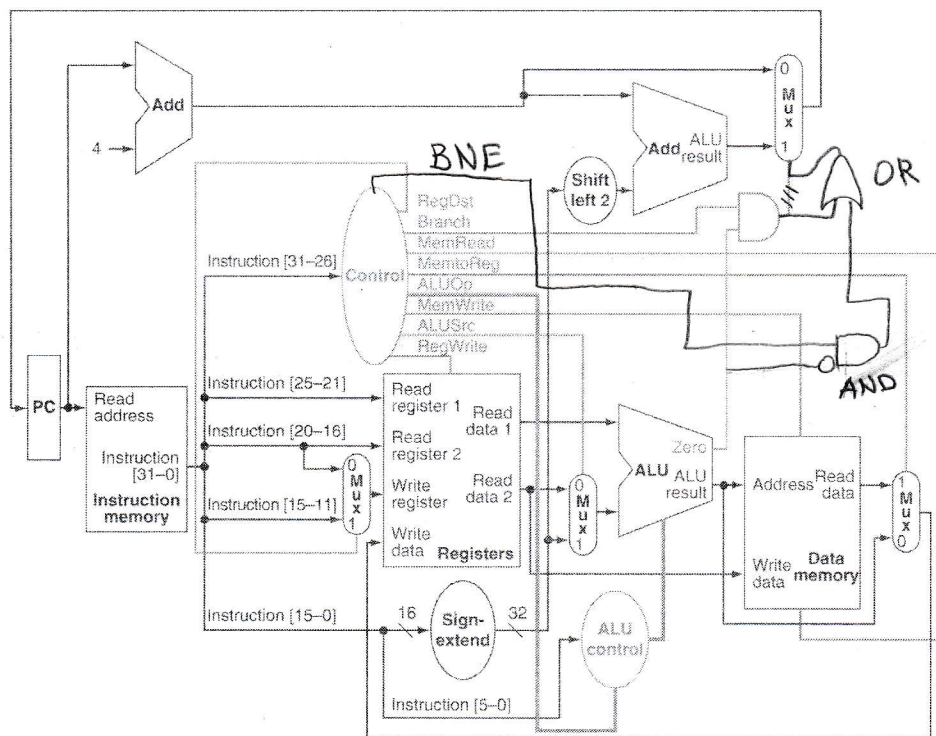
I can think of using two new logic gate & inverter with a new control path OR using a new Mux with the existing data path. I will use the first idea.