CMPEN 331 – Computer Organization and Design, Chapter 4 Review Questions

1. In this exercise we examine in detail how an instruction is executed in a single-cycle datapath. Problems in this exercise refer to a clock cycle in which the processor fetches the following instruction word:
   10101100011000100000000000010100
   Assume that data memory is all zeros and that the processor's registers have the following values at the beginning of the cycle in which the above instruction word is fetched:

r0	r1	r2	r3	r4	r5	r6	r8	r12	r31
0	–1	2	–3	–4	10	6	8	2	–16

   a. What are the outputs of the sign-extend and the "Shift left 2" unit (The simple control and datapath are extended to handle the jump instruction)) for this instruction word?

   b. What are the values of the ALU control unit's inputs for this instruction?

   c. Show the values of the control lines shown in the table.

   d. For the ALU and the two add units, what are their data input values?

   e. What are all inputs for the "Registers" unit?

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   f. What are the outputs of the sign-extend and the "Shift left 2" unit (The simple control and datapath are extended to handle the jump instruction)) for this instruction word?

Sign-extend	Shift-left-2
00000000000000000000000000010100	00000000000000000000001010000

   g. What are the values of the ALU control unit's inputs for this instruction?

ALUOp[1-0]	Instruction[5-0]
00	010100

   h. Show the values of the control lines shown in the table.

RegDst	ALU Src	Memto-Reg	Reg-Write	Mem-Read	Mem-write	Branch
X	1	X	0	0	1	0

   i. For the ALU and the two add units, what are their data input values?

ALU	Add (PC+4)	Add (Branch)
-3 and 20	PC and 4	PC+4 and 20*4

   j. What are all inputs for the "Registers" unit?

Read Register 1	Read Register 2	Write Register	Write Data	RegWrite