

CSC320 – Computer Organization and Architecture

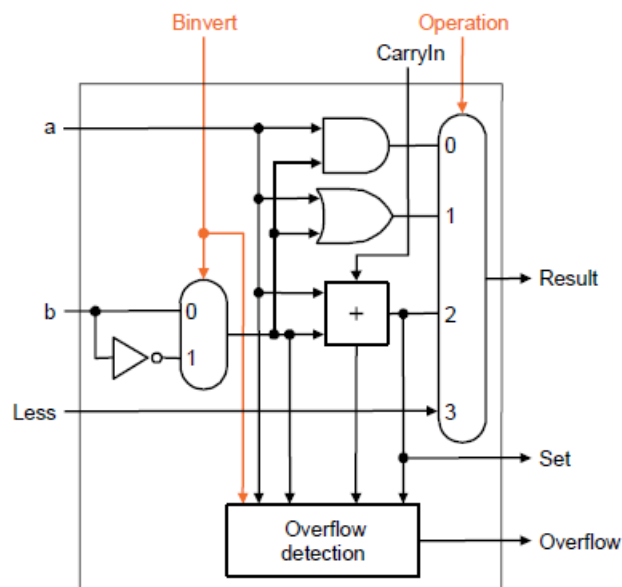
Assignment #3 (Due Date: Monday, 11/16/2020 at 11:59pm)

Chapter 3:

1. Using a table similar to that shown in CH3-2 slide #11 (Third version of Multiply Example), calculate the **product** of decimal integers 50 and 10 (binary: $110010 * 001010$). Note: assume both inputs are 6-bit unsigned integers. (25 points)
2. Using a table similar to that shown in CH3-2 slide #15 (Final version of Division Example), calculate decimal integers 60 **divided** by 17 (binary: $111100 \div 010001$). Note: assume both inputs are 6-bit unsigned integers. (30 points)
3. Write down the IEEE 754 binary representation of the decimal number **63.25**
 - a). assuming 32-bit **single** precision format (20 points)
 - b). assuming 64-bit **double** precision format
4. Let $a = 0110\ 1011\ 0010\ 0011$ and $b = 1101\ 1110\ 1010\ 1001$. Use the Carry Lookahead 16-bit adder (see CH3-2 slides #5 & #6) to calculate the 16th bit carry out **C₄** (like what did in the classroom). (25 points)

$$\mathbf{C}_4 = \mathbf{G}_3 + \mathbf{P}_3\mathbf{G}_2 + \mathbf{P}_3\mathbf{P}_2\mathbf{G}_1 + \mathbf{P}_3\mathbf{P}_2\mathbf{P}_1\mathbf{G}_0 + \mathbf{P}_3\mathbf{P}_2\mathbf{P}_1\mathbf{P}_0\mathbf{c}_0$$

5. Below is the bit 31 (the leftmost bit) of a MIPS 32-bit ALU in CH3-1 (see slide #26). Draw the detailed circuits (using logic gates AND, OR, NOT and a 2-bit Multiplexer) for the “Overflow detection” unit based on the overflow conditions that are defined in CH3-1 slide #14. The output “Overflow” is a 1 whenever overflows occur. Otherwise, it’s a 0. Note the unit has 5 inputs (left-to-right: Binvert, a31, b31, carry-out31, result31) and one output. (20 points)

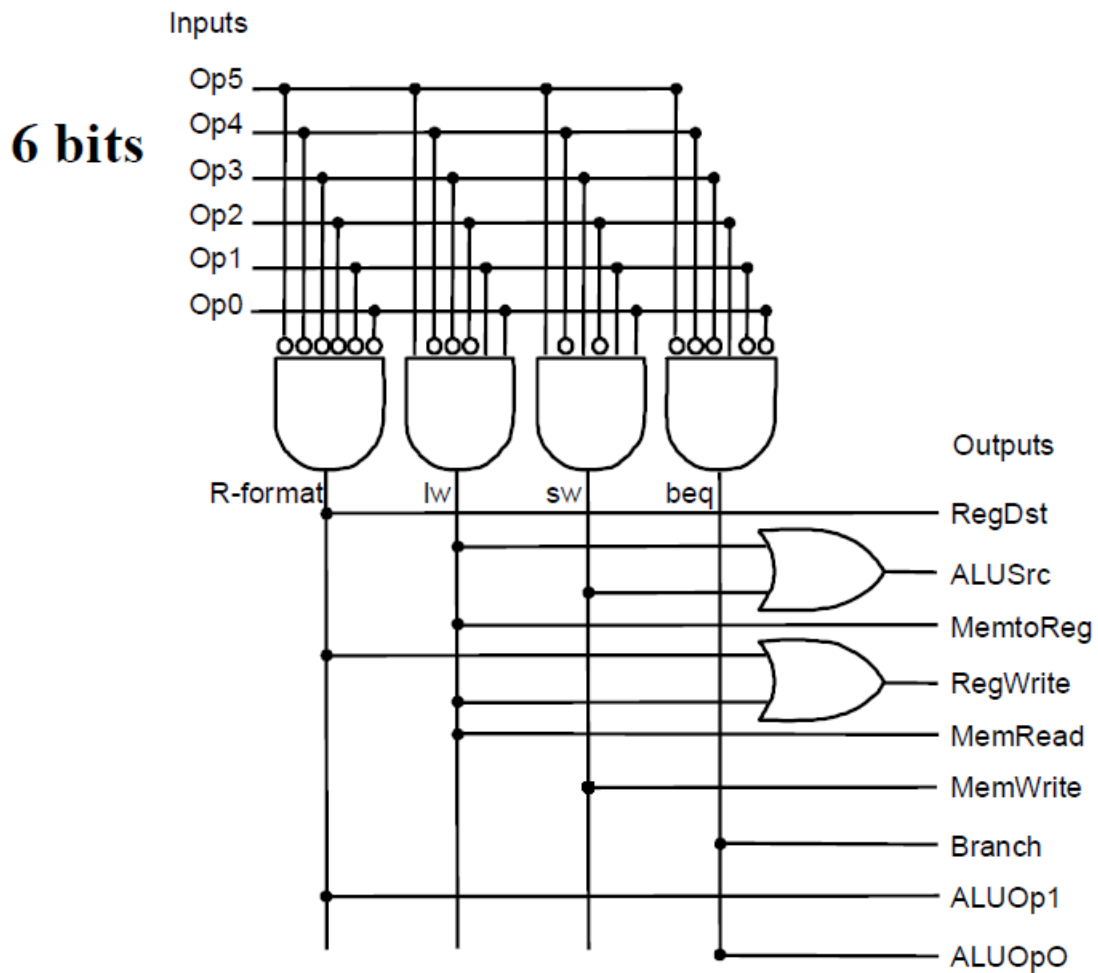


6. Answer questions a) to d) below:

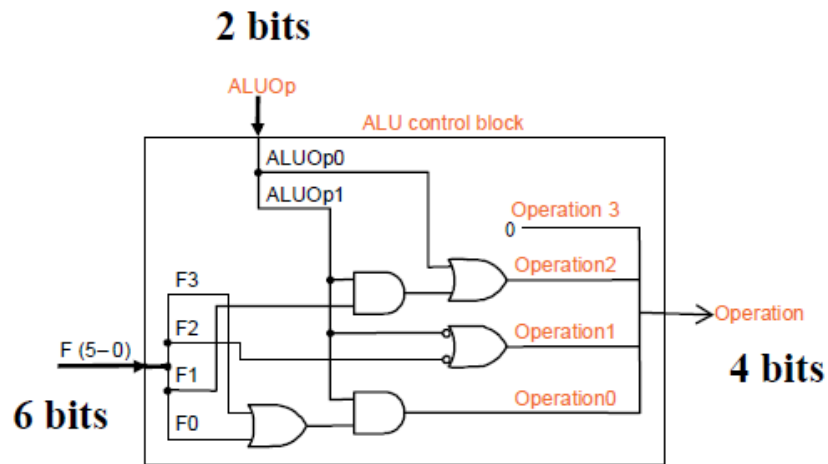
a). Convert the MIPS assembly code below into a 32-bit MIPS instruction format (in **binary**).
(10 points)

or \$t0, \$a1, \$a2

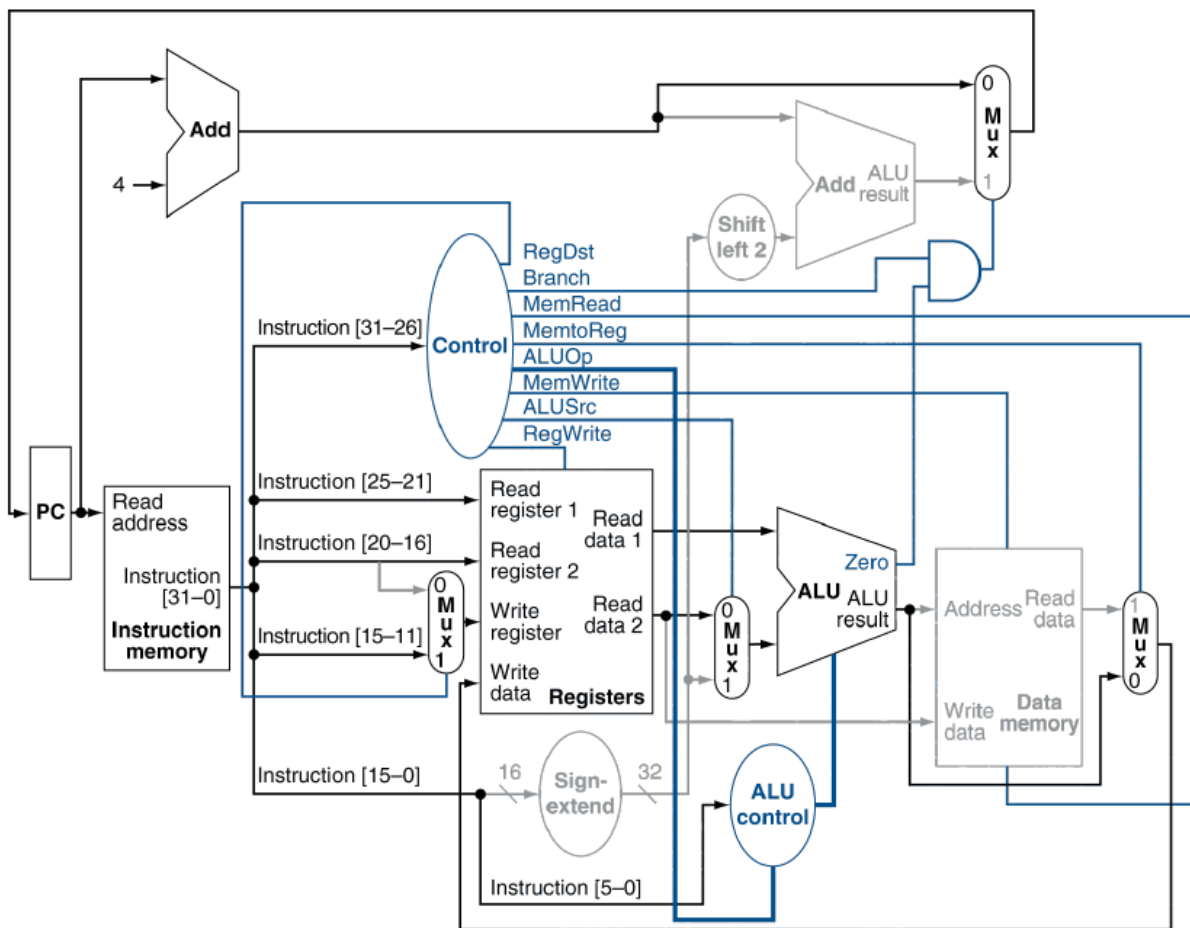
b). Given the “Control” unit below, use your answer from a) and “label” each line (0 or 1) for the unit. You must show your work which leads to the answers (0 or 1) for the 9 outputs (RegDst, ALUSrc, ...).
(20 points)



- c). Given the “ALU Control” unit below, use your answers from a) and b) and “label” each line (0 or 1) for the unit. You must show your work which leads to the answers (0 or 1) for the 4-bit Operation output. (20 points)



- d) Given the MIPS processor diagram (datapath and control units) below, use your answers from b) and c) and label/show “ALL” data paths and their control bits (like what we did in the classroom) for the diagram. (30 points)



Chapter 4 (pipelining/forwarding):

7. Consider the following MIPS instructions with basic 5-stage pipeline cycles. Fill in the pipeline diagram indicating the cycle when each stage for each instruction will be performed (as was done in class).

a) Assuming “No-Forwarding” (no EX->EX, MEM->EX, nor WB->ID) and “One-memory system” (IF-MEM hazard) are used.

	1	2	3	4	5	6	7	8	9	10	11	12	13
or \$1, \$2, \$3													
or \$2, \$1, \$4													
or \$1, \$1, \$2													

b) Assuming “Full-Forwarding” and “Two-memory system” (no IF-MEM hazard) are used.

Note: Indicate when a value is forwarded from one stage of an instruction to a stage of a different instruction by drawing a line connecting the two stages (as was done in class).

	1	2	3	4	5	6	7	8	9	10	11	12
or \$1, \$2, \$3												
or \$2, \$1, \$4												
or \$1, \$1, \$2												

c) Assuming “Full-Forwarding” and “Two-memory system” (no IF-MEM hazard) are used.

Note: Indicate when a value is forwarded from one stage of an instruction to a stage of a different instruction by drawing a line connecting the two stages (as was done in class).

	1	2	3	4	5	6	7	8	9	10	11	12
lw \$1, 0(\$2)												
addi \$2, \$2, 4												
add \$1, \$1, \$3												
and \$3, \$1, \$2												
sw \$1, 0(\$2)												

*** Please Read (To turn in your answers):

1. Use your phone to take photos of your answers (or scan). Please reduce the resolution/size of the images if possible.
2. Email your files (acceptable formats: pdf, jpg, jpeg, gif, doc, or docx) with email subject “CSC320 Assignment #3” to tuh@easternct.edu