ALU and Microcode
Due: October 15, 2019 at 23:55 on MyCourses

Tutorials C and D will be helpful for this assignment. Tutorial C covers registers and complex circuits. Tutorial D explores microcoding. The assignment assumes yours familiarity using LOGISIM.

QUESTION ONE: The ALU in LOGISIM

Using LOGISIM built the ALU chip set: L and R registers, the ALU, the Status register, and the A-out register. The 4-bit L and R registers will have input pins to help initialize those registers. The Status and A-out registers will have output pins so the TA can easily see the results. The ALU register will have an input pin to tell it what operations to do. The valid operations are: L + R and L – R. L and R are assumed to contain only integer values in +ve (absolute value integer) or 2's complement form, before the operation is applied. The ALU input pin, when set to 0 will perform L + R, when set to 1 will perform L – R. The status register will detect the following: bit 0 = overflow, bit 1 = signed overflow, bit 2 = zero value, and bit 3 = negative value.

You are permitted to use the following LOGISIM components: the half-adder, the register, the black box, the clock, the flip-flop, AND-gate, OR-gate, NOT-gate, XOR-gate, wires, input pins, and output pins.

Design your solution to follow this template:
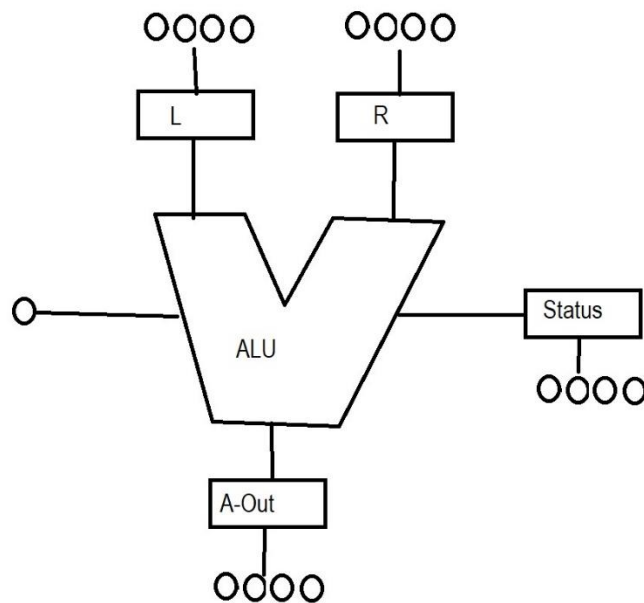
Note: the ALU box does not need to look like the above diagram but try to keep the general arrangement of the parts.

QUESTION TWO: BEQ Microcode

The macro instruction BEQ means branch-when-equal-to. The instruction's syntax is:

BEQ VALUE1, VALUE2, DESTINATION

VALUE1 and VALUE2 can be integer constants or register addresses. A register address means that BEQ uses the value stored in that register, not the address. BEQ compares these two values to determine when they are equal. If they are equal, then the IP (or PC) is assigned the DESTINATION address. This causes the program to execute code from this new location.

For this question, answer the following:

a) In a single sentence, state how the ALU and the Status register is used to accomplish the VALUE1 and VALUE2 equality test?
b) Assume that the IP (or PC) can receive an address from one of two possible sources (eg. from the IR, or from the Incrementer). In a single sentence, state how the Status register and some gates can be used to select which address source (i.e. [IP] = [IR(address)] or [IP] = [Incrementer]).
c) Using the microcode writing technique covered in class, write all the microcode steps needed to perform BEQ assuming VALUE1 and VALUE2 are both registers.
d) How many clock ticks are required to carry out this operation?

WHAT TO HAND IN

1) The LOGISIM circuit file. The TA must be able to load and execute your circuit.
2) A PDF file providing the answers to question 2.

HOW IT WILL BE GRADED

ALU add	: 3 points	Total points = 20
ALU subtract	: 3 points	Each question is graded proportionally
Status register	: 3 points	compared with the official solution.
Specified format	: 3 points	
Q2 a)	: 2 points	-5% per day late.
Q2 b)	: 2 points	After 2 late days, the assignment is not accepted.
Q2 c)	: 2 points	
Q2 d)	: 2 points	