

Name: _____

Date: _____

CS270 Homework Assignment 3 (HW3)

Due Thursday, March 31 (start of class)

Homework assignments are to be done individually.

Discussions regarding any part of the homework are **absolutely forbidden**.

Goals

Learn problem solving in LC-3 assembly and better understand the LC-3 machine architecture.
Completing the assignment requires LC-3 tool chain, which can be downloaded from the CS270 website.

The Assignment

Question 1 (25 points): Develop an algorithm and express it as a flowchart for right shifting an LC-3 word n times using “left shift with wrap around” only operations (i.e., the same algorithm you need to develop in order to implement the RIGHT_SHIFT_LSWA function in PA4). You may assume the input word is called “2SHIFT” and the number of times to shift is called “N”. Note that left shifting with wrap around means that any bits that would fall off the MSB after left shifting are copied back into the LSB end of the word. Draw the flowchart in the space provided or use a separate sheet.

Question 2 (25 points): Write a complete LC-3 assembly program (including .ORIG and .BLKW directives) to find the smaller of two input numbers A and B. The result of the comparison should be stored back into a variable called SMALLER. Note that A and B are 2's complement numbers, so you need to handle both negative and positive numbers in your comparison. Also, you need to handle the case when both A and B are equal. Examples: if A = -3 and B = -5, then SMALLER should have -5. If A = -2 and B = -2, then SMALLER should be -2.

Write the assembly program, simulate it using lc3sim, and verify the program for all test cases (that you can come up with). We will provide you with a drop box to submit the assembly source file. Name your source file **hw3-q2.asm**. You should also attach a copy of your source file with this homework.

Question 3 (25 points): Disassemble the following LC-3 program given in hexadecimal format and describe the function this program is attempting to implement. (Hint: Disassembling this program can be made easy if you know the right combination of tools to use)

In HEX	In Binary														Instruction/Directive			
3010	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	.ORIG
4801																		
F025																		
2206																		
2406																		
94BF																		
14A1																		
1642																		
3603																		
C1C0																		
0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.BLKW 1
0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.BLKW 1
0000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.BLKW 1

What function is this program attempting to implement?

Question 4 (25 points): Manually assemble the following program and produce a HEX file.

Instruction/Directive	In Binary																In HEX
.ORIG 0x3000	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	3000
LD R1, LABEL1																	
LD R2, LABEL2																	
ADD R3, R3, #0																	
ADD R3, R3, R1																	
ADD R3, R3, R2																	
ST R3, LABEL3																	
HALT																	
LABEL1 .FILL 0x1111																	
LABEL2 .FILL 0x0006																	
LABEL3 .BLKW 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000

Submission Instructions

All homework assignments must be handed in at the **beginning** of class on the due date.

Late Policy

Note late submissions are accepted for this homework assignment.