CS 3101 Computer Organization

Homework 4

**Due Date: Friday, October 19, 2018 at class time**

Type your answers in a word processor, print and submit hardcopy in class. Do not handwrite.

***Show your steps to receive partial credit.***

1. A digital computer has a memory unit with 30 bits per word. The instruction set consists of 58 different operations. All instructions have an operation code part (opcode) and two address fields: one for a memory address and one for a register address. This particular system includes eight general-purpose, user-addressable registers. Registers may be loaded directly from memory, and memory may be updated directly from the registers. Direct memory-to-memory data movement operations are not supported. Each instruction is stored in one word of memory.

a. How many bits are needed for the opcode?

6

b. How many bits are needed to specify the register?

3

c. How many bits are left for the memory address part of the instruction?

30 – 6 - 3 = 21

d. What is the maximum allowable size for the memory?

221

e. What is the largest unsigned binary number that can be accommodated in one word of the memory?

230 - 1

1. List the hexadecimal code for the following program (hand assemble it), and predict what will be stored in memory location 10B after the program is executed.

Hex Address Label Instruction Hexcode

100 Load A 1109 22

101 Add One 3108 22 + 1 = 23

102 Jump S1 9106 23 – 14 = 9

103 S2, Subt One 4108 9 – 1 = 8

104 Store C 210B 10B = 8

105 Halt 7000

106 S1, Subt B 410B

107 Jump S2 9103

108 One, HEX 0001 0001

109 A, HEX 0022 0022

10A B, HEX 0014 0014

10B C, HEX 0000 0000

1. Write the assembly language equivalent of the following MARIE machine language instructions:

a. 0100|010111000010

Subt 5C2

b. 0001|001110011010

Load 39A

c. 1100|000101101100

JumpI 16C