Computer Science 304
Computer Organization
Spring 2025
Assignment 11

Due: beginning of class, Tuesday, 4/29/25

Answer the following questions and submit solutions by the due date. Show your work for full credit. All submissions must be completely your own work.

1. [10 points] For a computer with word size of 16 bits using two's complement, compute the following system values in a power of 2 and decimal for (a), and both binary and decimal for (b)-(e).

   a. Number of values
   b. Min unsigned integer
   c. Max unsigned integer
   d. Min signed integer
   e. Max signed integer

2. [6 points] Suppose a = 1010 1001 1011 and b = 0111 1010 1010. Compute the following using binary operations assuming 12-bit two's complement. Express your final answers in both binary and hexadecimal. (Be careful to distinguish between ~ and –).

   a. –b & (a ^ ~b) [i.e., minus b, tilde b]
   b. – ((–a & b) | ~a) [i.e., minus at beginning, minus a, tilde a]

3. [6 points] Suppose a = 1010 1001 1011 and b = 0111 1010 1010, as in problem 2. Compute the following using 12-bit two's complement binary operations and arithmetic shift where necessary. Express final answers in both binary and hexadecimal. Also, state whether each involves positive overflow, negative overflow, both positive and negative overflow, or no overflow.

   a. b – (–a >> 2)
   b. (a >> 4) + ((– b) << 3)

4. [3 points] Convert –454 to 12-bit two's complement binary, then map to an unsigned value using the T2U translation found in the slides. Represent your final answer in decimal.

5. [3 points] Convert 1999 to binary, then map to 12-bit two's complement using the U2T translation found in the slides. Represent your final answer in decimal.

6. [6 points] Using the IEEE single precision floating point format, convert the following decimal values into binary strings

   a. 139.75
   b. -62.5×2^{-140}

7. [6 points] Using the IEEE single precision floating point format, convert the following binary strings into decimal values. First, show the value in binary (e.g., -1.11×2^5), then show it in scientific notation (with powers of 10) and round decimals to the nearest hundredth.

   a. `1 00101010 11010..0`
   b. `0 00000000 000110..0`

8. [4 points] Assuming an 8-bit IEEE binary string for floating point representation, with 1 bit for the sign, 3 bits for the exponent, and 4 bits for the significand (somewhat similar to Slide 28 in the Chapter 2 Floating Point notes), find the sum of the following two IEEE values. Show the exact result in binary and the binary result in the 8-bit IEEE format after fixing.

   ```
   0 011 1010
   0 101 0110
   ```

9. [3 points] Given the following memory expressions, state the value of each.

Address	Value
0x200	0xE4
0x204	0xB9
0x208	0x1F
0x20C	0x02

Register	Value
%eax	0x200
%ecx	0x01
%edx	0x04

   a. `(%eax,%ecx,8)`
   b. `4(%eax,%edx,2)`
   c. `0x1E0(,%edx,8)`

10. [3 points] For each of the following, state the equation that the instruction represents. The first result has been done for you. Provide all values in decimal.

Assume: %eax = x; %ecx = y; %edx = z;	
INSTRUCTION	**RESULT**
`leal (%edx, %edx, 2), %ecx`	(a)
`leal 23(, %ecx, 4), %edx`	(b)
`leal 0XC(%eax, %edx, 8), %eax`	(c)