

Computer Science 304
Computer Organization
Spring 2025
Assignment 2

Due: beginning of class, Thursday, 2/13/2025

Answer the following questions and submit solutions at the beginning of class on the due date. Show your work for full credit. All submission must be completely your own work.

1. [10 points] In the following, use 8-bit binary values to represent sets over the domain {a, b, c, d, e, f, g, h} and perform operations on them. Sets should conform to the following mapping:

set element:	a b c d e f g h	example: 10010001 represents {a, d, h}
position:	7 6 5 4 3 2 1 0	

- a. Show the binary representation for set S , where $S = \{a, b, f, g\}$.
- b. Show the binary representation for set T , where $T = \{b, c, e, g, h\}$.

For parts c-e, compute the requested sets by performing the appropriate bit-wise operator on the binary representations. Show both the final bit string and the final set.

- c. $S \cup T$
- d. $S \cap \overline{T}$
- e. $\overline{S} \oplus T$ [symmetric difference]

2. [12 points] Suppose $a = 1001\ 1101\ 0011$, $b = 1101\ 1000\ 0100$, $c = 0110\ 0110\ 1011$. 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. $a + b$
- b. $(a \gg 4) + c$
- c. $(c \ll 2) + b$
- d. $(c \gg 3) * ((-b) \gg 5)$

3. [8 points each] Using the values of a , b , and c from problem 2, evaluate the following C logical expressions using 12-bit two's complement binary operations and logical shift where necessary. Hint: Keep in mind that these are C expressions when writing your final answer.

- a. $(a > 0) \ || \ !(a \ \& \ b)$
- b. $(b < 0) \ \&\& \ (c \gg 10)$
- c. $(c < 0) \ || \ (a \ \&\& \ b)$
- d. $(\sim a \wedge b) \ \&\& \ (\sim c \ \& \ c)$ [both tildes]

4. [6 points] Convert the following decimal values to 8-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.
- a. -119
 - b. 52
 - c. -83
5. [6 points] Convert the following unsigned decimal values to binary, then map to 8-bit two's complement using the U2T translation found in the slides. Represent your final answer in decimal.
- a. 251
 - b. 128
 - c. 186
6. [8 points] For each of the following pairs of values, state the relation and evaluation, as shown on Slide 42 in the Chapter 2 course notes. Word size is 10 bits.
- a. 511, (unsigned int) -512
 - b. -500, (int) 1020U
 - c. (int) 1023U, -1
 - d. $511 + 1$, $512 - 1$