

# ***Binary Integers***

*CS 350: Computer Organization & Assembler Language Programming*

*Lab 2, due Wed Jan 27 (2400 hrs) \**

[1/22: p.1]

## **A. Why?**

- A basic way to store information in a computer is to use binary integers.
- There are multiple ways to represent negative integers.

## **B. Outcomes**

After this lab, you should be able to

- Represent binary integers in sign-magnitude, 1's complement, or 2's complement; to list the pros and cons of each of these three systems and to explain why hardware commonly uses 2's complement to represent negative integers.
- List the representations of the most positive and negative values in each system; know when overflow occurs and how to recognize it.

## **C. Problems [50 points total]**

1. [1 pt] In sign-magnitude, 1's complement, and 2's complement, unsigned 110111 equals what decimal value?
2. [3 pts] Let  $V$  be the value from Problem 1; what is the **6-bit** representation of  $-V$  in (a) sign-magnitude, (b) 1's complement, and (c) 2's complement? [upd 1/22]
3. [3 pts] Reading 110111 as a signed 6-bit value, what are the bitstring and decimal representations of  $-(110111)$  in (a) sign-magnitude, (b) 1's complement, and (c) 2's complement?
4. [6 = 3\*2 pts] What is the bitstring and decimal value for the most negative 6-bit number in (a) sign-magnitude, (b) 1's complement, and (c) 2's complement?

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\* Have you read the syllabus to find out how to get an automatic one-day extension?

5. [6 = 3\*2 pts] What is the bitstring and decimal value for the most negative  $n$ -bit number in (a) sign-magnitude, (b) 1's complement, and (c) 2's complement?
6. [4 pts] Which of the three systems have two forms of zero ("positive" and "negative" zero), and how do you write them in each of those systems?
7. [2 pts] In which (if any) of the three systems does taking the negative of the most negative number cause overflow? What about the negative of the most positive number?
8. [2 pts] What is  $111011 + 001110$ , using unsigned addition? Does overflow occur?
9. [2 pts] What is  $111000 - 001101$ , using unsigned subtraction?

For Problems 10 – 12, rewrite the following additions and subtractions in 6-bit 2's complement. E.g.,  $-3 - 5 = -000011 - 000101 = 111101 - 000101 = 111101 + 111011 = 111000 = -001000 = -8$

10. [7 pts]  $13 - 30 = -17$
11. [7 pts]  $-25 - 7 = -32$
12. [7 pts]  $24 + 10 = ???$  (Be sure to show the decimal result; you should get overflow.)

### ***D. How to Submit Labs***

See <http://cs.iit.edu/~cs350> → Syllabus > Labs > Submitting Work for your options.