

CS 350 Activities for Lecture 2

Activity 2.1: Binary Integers

A. Why?

- Binary integers are one of the basic ways to store information in a modern computer.

B. Outcomes

At the end of this activity you should:

- Know the three ways to represent signed binary integers.
- Know how to take the negative of a binary number in each system.
- Know how to do subtraction in two's complement.
- Know what overflow looks like and when it occurs.

C. Questions

In group, discuss the questions below.

1. Complete the following table of representations of 4-bit bitstrings as unsigned, sign-magnitude, 1's complement, and 2's complement binary numbers: Fill in each entry with the decimal number represented by the bitstring, using the given representation technique.

Bitstring	Unsigned	Sign-Magnitude	1's Complement	2's Complement
0111	7			
0110	6			
0101	5			
0100	4			
0011	3			
0010	2			
0001	1			
0000	0			
1111				
1110				
1101				
1100				
1011				
1010				
1001				
1000				

2. Use your table to answer the following questions
 - a. What decimal number does 0010 represent in sign-magnitude, 1's complement, and 2's complement?
 - b. What is the bit-flip of 0010 (i.e., the bitstring that results from flipping the bits of 0010)?
 - c. What (decimal number) does the bitstring from (b) represent in sign-magnitude?
 - d. ... in 1's complement?
 - e. ... in 2's complement?
3. Rewrite the following subtractions in binary, using 5-bit 2's complement. (E.g., $3-1$ is rewritten as $00011 - 00001 = 00011 + (-00001) = 00011 + (11110 + 1) = 00011 + 11111 = 00010$.)
 - a. $7-5 = 2$:
 - b. $6-8 = -2$:
 - c. $-5-10 = -15$:
 - d. $-12-4 = -16$:
 - e. $-9-9 = ????$
4. With an 8-bit number
 - a. What is the largest positive number that can be represented? (unsigned? signed?)
 - b. What is the largest negative number (i.e., most negative) that can be represented in sign-magnitude?
 - c. ... in 1's complement?
 - d. ... in 2's complement?
5. With an n -bit number
 - a. What is the largest positive number that can be represented? (unsigned? signed?)
 - b. What is the largest negative number (i.e., most negative) that can be represented in sign-magnitude?
 - c. ... in 1's complement?
 - d. ... in 2's complement?