

# HW Problem 01: Signed Binary Number Representations

Tuesday, September 1, 2020 1:13 PM

Let  $A = +107_{10}$ ,  $B = -97_{10}$ , and  $C = -7_{10}$ .

(A) Determine the 8-bit signed binary representations for  $A$ ,  $B$ , and  $C$ .

A:  $+107_{10} \sim 01101011_2$

B:  $-97_{10} \sim 10011111_2$

C:  $-7_{10} \sim 11111001_2$

(B) Determine the 8-bit signed binary representations for  $-A$ ,  $-B$ , and  $-C$ .

A:  $-107_{10} \sim 10010101_2$

B:  $+97_{10} \sim 01100001_2$

C:  $+7_{10} \sim 0000111_2$

(C) Perform the long-hand addition to show that  $A$  and  $-A$  are additive inverses.

$$\begin{array}{r}
 \phantom{0}1\phantom{0}1\phantom{0}1\phantom{0}1\phantom{0}1\phantom{0}1\phantom{0}1 \\
 0\phantom{0}1\phantom{0}1\phantom{0}0\phantom{0}1\phantom{0}0\phantom{0}1\phantom{0}1\phantom{0}1_2 \\
 +1\phantom{0}0\phantom{0}0\phantom{0}1\phantom{0}0\phantom{0}1\phantom{0}0\phantom{0}1_2 \\
 \hline
 1\phantom{0}0\phantom{0}0\phantom{0}0\phantom{0}0\phantom{0}0\phantom{0}0 \sim 0_{10}
 \end{array}$$

(D) Determine the range of numbers representable using the 16-bit and 32-bit unsigned binary representations.

With  $n$  bits, the largest represented number is:

$$\sum_{l=0}^{n-1} 1 * 2^l = 2^n - 1, \quad 0 \leq M \leq 2^n - 1$$

$$2^{16} - 1 = 65535 \rightarrow 0 \leq M \leq 65535$$

$$2^{32} - 1 = 4,294,967,295 \rightarrow 0 \leq M \leq 4,294,967,295$$