Exercise series no. 2

Exercise 1

1. What are the ranges of 8-bit and 16-bit signed integers, in Signed Magnitude, One's Complement, and Two's Complement representations?
2. How many bytes are needed at a minimum to encode the value -512 with Signed Magnitude representation?
3. Consider an 8-bit representation of signed integers. Fill in the empty boxes in the following table :

Decimal	Sign-Magnitude	1's Complement	2's Complement
+27			
-45			
-128			
	11110101		
	01110101		
		10101001	
		00101001	
			11110010
			01110010

Exercise 2

1. What is the 16-bit sign-magnitude representation of the 8-bit sign-magnitude 10000111?
2. What is the decimal (base 10) value of $(C0)_{16}$ when read as:
    a. An unsigned integer.
    b. A signed integer.
3. Convert the following 16-bit two's complement numbers in hexadecimal representation to decimal :

    8000_{16} ; $00FF_{16}$

Exercise 3

Perform the following operations in binary arithmetic using 8-bit binary 2's complement representation. For each operation, indicate whether or not overflow has occurred.

a. $(107)_{10} - (67)_{10}$ b. $(-106)_{10} - (5)_{10}$ c. $(111)_{10} + (25)_{10}$ d. $(-126)_{10} - (85)_{10}$

Exercise 4

1. Express the following decimal numbers in IEEE 754 single-precision floating-point format. Express your answer in hexadecimal.
    a. $(+45)_{10}$ b. $(+13.5)_{10}$ c. $(-160.75)_{10}$ d. $(-32.625)_{10}$
2. Convert the following hexadecimal numbers from single-precision floating-point format to decimal:
    a. $(17BE0000)_{16}$ b. $(C3F00000)_{16}$

Exercise 5

1. Convert the following numbers to the corresponding number base:

   a. $(87)_{10} = (?)_2 = (?)_{BCD} = (?)_{GR} = (?)_{XS3}$
   b. $(153)_{10} = (?)_2 = (?)_{BCD} = (?)_{GR} = (?)_{XS3}$
   c. $(637)_8 = (?)_2 = (?)_{BCD} = (?)_{GR} = (?)_{XS3}$
   d. $(BC8)_{16} = (?)_2 = (?)_{BCD} = (?)_{GR} = (?)_{XS3}$
   e. $(1101001)_{BCD} = (?)_2 = (?)_{GR} = (?)_{XS3}$
   f. $(100011000)_{BCD} = (?)_2 = (?)_{GR} = (?)_{XS3}$
   g. $(1011001011)_{GR} = (?)_2 = (?)_{BCD} = (?)_{XS3}$
   h. $(100010010011)_{GR} = (?)_2 = (?)_{BCD} = (?)_{XS3}$
   i. $(11001010)_{XS3} = (?)_2 = (?)_{GR} = (?)_{BCD}$
   j. $(110001101011)_{XS3} = (?)_2 = (?)_{GR} = (?)_{BCD}$

2. What is the reflected binary representation of the decimal numbers from 13 to 25?

Additional exercises:

Exercise 6

1. Encode on 4 bits the integers **+7, +2, 0, −2, −7 and −8, +8** with the following representations:
   a. Signed Magnitude.
   b. One's Complement.
   c. Tow's Complement.
2. Indicate the value coded by 1101100101110101 which represents an integer signed in 2's Complement on 16 bits.
   - Same question with 0001000011101101.
3. Perform **(on 6 bits)** in **1's Complement** then in **2's Complement** the following operations:

   +19+5 ; +20+15 ; -13-12 ; -21-17 ; +19-3 ; +2-11 ; -18-14.

Exercise 7

Consider a 32-bit machine whose octal content is equal to $\mathbf{37724000000_{(8)}}$

What is the decimal equivalent of this content if we consider that it represents:

1. An integer value in **Signed Magnitude**.
2. An integer value in **One's Complement**.
3. An integer value in **Tow's Complement**.
4. A real value in **simple precision floating point (standard IEEE 754)** notation.

Exercise 8

Express in hexadecimal, the **simple precision floating point (IEEE 754)** representation of the following numbers:

$\mathbf{+64.5_{(10)}}$ $\mathbf{+8.375_{(10)}}$ $\mathbf{-2.625_{(10)} \times 2^{-129}}$ $\mathbf{+5_{(10)} \times 2^{-128}}$

Exercise 9

Consider the simple precision floating point (32 bits) of the IEEE 754 standard notation.

1. What are the largest and the smallest positive numbers in normalized form representable in the form $\mathbf{\pm a \times 2^b}$ (a and b are decimal).
2. Put in the form $\mathbf{\pm a \times 2^b}$ the two following hexadecimal contents:

   X =AE800000 , Y = AF600000
3. Calculate Z = X - Y
4. Deduce the representation of Z