

Spring Homework 1

1.

Row	8-Bit Binary	Hexadecimal	Decimal
1	1011 1100₂	BC ₁₆	188 ₁₀
2	0111 1101 ₂	7D₁₆	125 ₁₀
3	1001 0101 ₂	95 ₁₆	-107₁₀

Row 1: Hexadecimal: $1011_2 = B_{16}$, $1100_2 = C_{16} \rightarrow \mathbf{BC}_{16}$

Decimal: $(1 * 2^7) + (0 * 2^6) + (1 * 2^5) + (1 * 2^4) + (1 * 2^3) + (1 * 2^2) + (0 * 2^1) + (0 * 2^0) = 128 + 0 + 32 + 16 + 8 + 4 + 0 + 0 = \mathbf{188}_{10}$

Row 2: Binary: $7_{16} = 0111_2$, $D_{16} = 13_{10} = 1101_2 \rightarrow \mathbf{0111 1101_2}$

Decimal: $(7 * 16^1) + (D * 16^0) = 112 + 13 = \mathbf{125}_{10}$

Row 3: Binary: $107\%2 = 1$, $53\%2 = 1$, $26\%2 = 0$, $13\%2 = 1$, $6\%2 = 0$, $3\%2 = 1$, $1\%2 = 1 \rightarrow 0110 1011_2 = \mathbf{1001 0101_2}$

Hexadecimal: $1001_2 = 9_{16}$, $0101_2 = 5_{16} \rightarrow \mathbf{95}_{16}$

2. 8D28₁₆

a. Signed integer: $8D28_{16}$ ($0 - 7 = \text{positive}$, $8 - F = \text{negative}$) =
 $(15 - 8), (15 - (D = 13)), (15 - 2), (16 - 8) = 72D8 = (7 * 16^3) + (2 * 16^2) + (13 * 16^1) + (8 * 16^0) = 28672 + 512 + 208 + 8 =$
 $\mathbf{-29400}_{10}$

b. Unsigned integer: $(8 * 16^3) + ((D = 13) * 16^2) + (2 * 16^1) + (8 * 16^0) = 32768 + 3328 + 32 + 8 = \mathbf{36136}_{10}$

3. X: 01110011, Y: 10010100

a. In decimal: $X = 0111 0011_2 = (1 * 2^6) + (1 * 2^5) + (1 * 2^4) + (1 * 2^1) + (1 * 2^0) = \mathbf{115}_{10}$

$Y = \text{signed: } 1001 0100_2 (0 = \text{positive}, 1 = \text{negative}) =$

$0110 1100_2 = (1 * 2^2) + (1 * 2^3) + (1 * 2^5) + (1 * 2^6) = 4 + 8 + 32 + 64 = \mathbf{-108}_{10}$

b. Arithmetic operations *indicate overflow

i. $X + Y = 1001 0100_2 + 1001 0100_2 = (1) 0000 0111_2 = \mathbf{263}_{10}$

ii. $X - Y = 1001 0100_2 - 1001 0100_2 \rightarrow 1001 0011_2 + 0110 1100_2 = 1101 1111_2 \rightarrow 0010 0001_2 = \mathbf{-33}_{10}$

iii. $Y - X = 1001 0100_2 - 0111 0011_2 \rightarrow 1001 0100_2 + 1000 1101_2 = (1) 0010 0001_2 \rightarrow \mathbf{33}_{10}$

- c. Overflow occurs in step i and step iii. This is determined through seeing if the produced result is greater than what a given register can store—in this case, we are utilizing 8-bits, thus $0111\ 1111_2 \rightarrow -127_{10}$ to 127_{10} is the largest number that can be stored, in respect to signed numbers.
4. In 2's complement number system, we cannot use a 16-bit binary number to represent decimal number 40230_{10} . The maximum number is $0111\ 1111\ 1111\ 1111_2 \rightarrow -32768_{10}$ to 32767_{10} , where $40230_{10} > 32767_{10}$ —deeming it impossible to use a 16-bit binary number to represent the decimal number.