Exercise 7

Suppose that **A = 45** and **B = -13**, **C = 0** and **D** is a given number.

Notice: The placeholder for A, B, C and D is one byte (8 bits).

D is **unknown** and can be any number in the range of **0** and **255**.

D7	D6	D5	D4	D3	D2	D1	D0

1. Convert A, B and C to **binary** and **hexadecimal**
    a. A = **0b**00101101 = **0x**2D
    b. B = ~13 + 1 = **~0b**00001101 + **0b**00000001 = **0b**11110011 = **0x**F3
    c. C = **0b**00000000 = **0x**00
2. Calculate A + B, A - B, C - A and B - A.
    a. A + B = **0b**00101101 + **0b**11110011 = **0b**00100000
    b. A - B = **0b**00101101 - **0b**11110011 = **0b**00111010
    c. C - A = **0b**00000000 - **0b**00101101 = **0b**11010011
    d. B - A = **0b**11110011 - **0b**00101101 = **0b**11000110
3. Perform the following operations.
    a. A | B = **0b**00101101 | **0b**11110011 = **0b**11111111
    b. A & B = **0b**00101101 & **0b**11110011 = **0b**00100001
    c. A ^ B = **0b**00101101 ^ **0b**11110011 = **0b**11011110
    d. A << 3 = **0b**00101101 << 3 = **0b**01101000
    e. B >> 2 = **0b**11110011 >> 2 = **0b**11111100
    f. C >> 5 = **0b**00000000 >> 5 = **0b**00000000
    g. (A << 3) >> 3 = (**0b**00101101 << 3) >> 3 = **0b**01101000 >> 3 = **0b**00001101
    h. (~A & B) ^ (~C | A) =
        i. (~**0b**00101101 & **0b**11110011) ^ (~**0b**00000000 | **0b**00101101) =
        ii. (**0b**11010010 & **0b**11110011) ^ (**0b**11111111 | **0b**00101101) =
        iii. **0b**11010010 ^ **0b**11111111 = **0b**00101101
4. Using bitwise operators and masks
    a. Set the first and last bits of A: A | **0b**10000001 = A | (1 | (1 << 7)) = A | 129
    b. Toggle (Flip) the third bit of B: B ^ **0b**00000100 = B ^ (1 << 2) = B ^ 4

c. Read the value of 3rd and 4th bits of D (D2 and D3)

    i. (**0b**$D_7D_6D_5D_4D_3D_2D_1D_0$ >> 2) & **0b**00000011 =

    ii. **0b**00$D_7D_6D_5D_4D_3D_2$ & **0b**00000011 = **0b**000000D_3D_2 = (D >> 2) & 3

d. Change the 3rd and 4th bits of D to *10* (D3 to *1* and D2 to *0*)

    i. (D & **0b**11110011) | **0b**0000**10**00 = (D & 243) | 8

    ii. **0b**11110011 = **~0b**00001100 = **~**(**0b**00000011 << 2) = ~(3 << 2) = 243