Homework Assignment 2

(Due 2:10pm, Sep. 27, email to daehyun.kim@wsu.edu or submit a hardcopy)

You can use the following instruction only for this homework.

- Instructions
  - ADD R$, R%, R&
  - ADD R$, R%, #imm (#imm is a constant)
  - AND R$, R%, R& // logical AND
  - AND R$, R%, #imm (#imm is a constant)
  - ORR R$, R%, R& // logical OR
  - ORR R$, R%, #imm (#imm is a constant)
  - EOR R$, R%, R& // logical XOR
  - EOR R$, R%, #imm (#imm is a constant)

1. (20 points) Generate the following output signal Y from the input signal A using the instruction above. You can assume that A and Y are 4-bit registers.

- $A = a_3a_2a_1a_0$ (stored in R0)
- $Y = 01a_1\overline{a_0}$ (store Y in R2)

AND R2, R0, #0x7 // R2 = $0a_2a_1a_0$

ORR R2, R2, #0x4 // R2 = $01a_1a_0$

EOR R2, R2, #0x1 // R2 = $01a_1\overline{a_0}$

2. (30 points) Generate the following output signal Y from the input signals A and B using the instruction above. You can assume that A, B, and Y are 4-bit registers.

- $A = a_3a_2a_1a_0$ (stored in R0)
- $B = b_3b_2b_1b_0$ (stored in R1)
- $Y = \{a_3\&b_3\}\{a_2|b_2\}\{a_1\}\{b_0\}$ (store Y in R2). In other words, if $Y = y_3y_2y_1y_0$, then
  - $y_3 = a_3$ AND b_3
  - $y_2 = a_2$ OR b_2
  - $y_1 = a_1$
  - $y_0 = b_0$

AND R3, R0, R1 // R3 = $\{a_3\&b_3\}XXX$

AND R3, R3, #0x8 // R3 = $\{a_3\&b_3\}000$

ORR R4, R0, R1 // R4 = $X\{a_2|b_2\}XX$

AND R4, R4, #0x4 // R4 = $0\{a_2|b_2\}00$

ORR R2, R3, R4 // R2 = $\{a_3\&b_3\}\{a_2|b_2\}00$

AND R3, R0, #0x2 // R3 = $00a_1 0$

ORR R2, R3, R2 // R2 = $\{a_3\&b_3\}\{a_2|b_2\}a_1 0$

AND R3, R1, #0x1 // R3 = $000b_0$

ORR R2, R3, R2 // R2 = $\{a_3\&b_3\}\{a_2|b_2\}a_1 b_0$

3. (50 points) Generate the following output signal Y from the input signals A and B using the instruction above. You can assume that A, B, and Y are 4-bit registers.

- $A = a_3 a_2 a_1 a_0$ (stored in R0)
- $B = b_3 b_2 b_1 b_0$ (stored in R1)
- $Y = A + 2$ if B is an even number and $A + 1$ if B is an odd number. (store Y in R2)
    - (You don't need to worry about overflows.)

ORR R3, R1, #0xE // R3 = $111b_0$

EOR R3, R3, #0xF // R3 = $000\overline{b_0}$

ADD R2, R0, #0x1 // R2 = $A + 1$

ADD R2, R2, R3 // R2 = $A + \overline{b_0}$

If B is even, b_0 is 0 (i.e., $\overline{b_0} = 1$). In this case, we add 2 to A.

If B is odd, b_0 is 1 (i.e., $\overline{b_0} = 0$). In this case, we add 1 to A.

Thus, we first add 1 to A unconditionally, and then add $\overline{b_0}$ to A.