CSE340: Computer Architecture

Chapter 3 Practice Problems

1. Consider A = 5ED8 and B = 3C91 as signed 16-bit hexadecimal numbers. **Determine** whether A - B causes overflow or not. Show all the necessary work.

2. **Calculate** the product of the two hexadecimal unsigned 4-bit integers C and A using the long-multiplication approach (using the hardware with one 4-bit register and two 8-bit registers). Consider C as multiplicand and A as multiplier in the calculation. You have to show the contents of each register on each step in an iteration.
   Hint: The values of C and A in decimal are 12 and 10 respectively.

3. **Calculate** the product of the two hexadecimal unsigned 4-bit integers C and A using the optimized-multiplication approach (using the hardware with one 4-bit register and one 8-bit register). Consider C as the multiplicand and A as the multiplier in the calculation. You have to show the contents of each register on each step in an iteration.
   Hint: The values of C and A in decimal are 12 and 10 respectively.

Solutions:

1. A = 0101 1110 1101 1000= (24280)decimal
   B = 0011 1100 1001 0001= (15505)decimal
   A-B= 24280-15505= 8775

   2's complement of B = 1100 0011 0110 1111

   A - B = A + (2's complement of B) = 0101 1110 1101 1000
   1100 0011 0110 1111

   0010 0010 0100 0111

   No overflow because subtraction of two positive numbers will not cause overflow. Moreover, subtracting B from A should result in a positive number and MSB bit 0 of the result shows it is a positive number.

2. $(C)_{16} \times (A)_{16} = (12)_{10} \times (10)_{10} = (120)_{10}$ OR $(1100)_2 \times (1010)_2 = (0111\ 1000)_2$

Iteration	Step	Mutiplicand (8bits) (M1)	Multiplier (4bits) (M2)	Product (8bts)
0	init	0000 1100	1010	0000 0000
1	No Opt	0000 1100	1010	0000 0000
	M1←	0001 1000	1010	0000 0000
	M2→	0001 1000	0101	0000 0000
2	Add	0001 1000	0101	0001 1000
	M1←	0011 0000	0101	0001 1000
	M2→	0011 0000	0010	0001 1000
3	No Opt	0011 0000	0010	0001 1000
	M1←	0110 0000	0010	0001 1000
	M2→	0110 0000	0001	0001 1000
4	Add	0110 0000	0001	0111 1000
	M1←	1100 0000	0001	0111 1000
	M2→	1100 0000	0000	0111 1000 (Ans.)

3. $(C)_{16} \times (A)_{16} = (12)_{10} \times (10)_{10} = (120)_{10}$ OR $(1100)_2 \times (1010)_2 = (0111\ 1000)_2$

Iteration	Step	Multiplicand (4bits) (Mult)	Product (8bits) (Prod)
0	Initialization	1100	0000 1010
1	No Opt.	1100	0000 1010
	Prod >> 1	1100	0000 0101
2	Addition	1100	1100 0101
	Prod >> 1	1100	0110 0010
3	No Opt.	1100	0110 0010
	Prod >> 1	1100	0011 0001
4	Addition	1100	1111 0001
	Prod >> 1	1100	0111 1000 (Ans.)