HW1 Solutions ECE2060 Spring 2019

Lectures Covered: Lesson1 - Lesson4

Show all relevant steps. Don't just write down the answers.

Late HWs will not be accepted. Turn in the HWs in class. **HWs turned-in anywhere else will not be accepted.**

Show your work on these pages, attach additional pages if necessary.

- Be sure to organize the pages **in order** and **staple** them all together, **otherwise you will lose one point**
- Fill out the following. **You will lose an additional point if you fail to provide these details**

Your Last Name_____ Your First Name_____

Problems start from next page. Problems 1, 4, 5, 7, 10 were grades

1) The bits of $(-30)_{10}$ are to be placed in a 16 bit register (using 2's compliment representation). Show all the 16 bits in this register.

$(30)_{10} \rightarrow 0000,0000,0001,1110$

to get $(-30)_{10}$ take 2's compliment

$(-30)_{10} \rightarrow 1111,1111,1110,0010$

2) The bits of $(30)_{10}$ are to be placed in a 16 bit register (using 2's compliment representation). Show all the 16 bits in this register.

$(30)_{10} \rightarrow 0000,0000,0001,1110$

3) Let a =$(01111111)_2$ and b = $(2)_{10}$, assume that we are using signed binary numbers (2's compliment representation) stored in 8 bit registers. Let c = a + b.

i) What answer do you get for c (as a decimal number) if you use rules of addition of 2's compliment (show all your steps)

ii) By using the argument based on "carry out of signed bit" and "carry into the signed bit" determine if there is overflow in this addition. Can the result for c obtained above be trusted?

$C = a + b$

$$\begin{array}{r} 0\ 1111111 \\ 01111111 \\ 00000010 \\ \hline 10000001 \end{array}$$

$C = (-127)_{10}$

carry into the signed bit 1 is not equal to carry out of the signed bit 0

∴ there is overflow. The result for c can not be trusted

4) Let a =$(11100000)_2$ and b = $(-1)_{10}$, assume that we are using signed binary numbers stored in 8 bit registers. Let c = a - b.

i. What answer do you get for c (as a decimal number) if you use rules of addition in 2's complements representation (show all steps)

ii. By using the argument based on "carry out of signed bit" and "carry into the signed bit" determine if there is overflow in this addition. Can the result for c obtained above be trusted?

a = 1110,0000

b = 1111,1111

c = a − b = a + (−b)

0 0

1110,0000

0000,0001

c = 1110,0001

$C = (-31)_{10}$

carry out of sign bit = carry into sign bit = 0 ∴ no overflow

5) Express $(10000000)_2$ as a decimal number (assume 8 bit registers),

i) If the above number is assumed to be represented in 2's compliment representation

ii) If the above number is assumed to be represented in unsigned numbers representation

i) 1000,0000 = 1,1000,000 2's comp. is 0,1000,000 = 128

∴ 1000,0000 = −128

ii) 1000,0000 = 2^7 = 128

6) Express $(30.625)_{10}$ as a binary number. Show all your steps.

$(30)_{10} \rightarrow \quad \frac{30}{2} = 15 + \frac{0}{2}$

$\frac{15}{2} = 7 + \frac{1}{2}$

$\frac{7}{2} = 3 + \frac{1}{2}$

$\frac{3}{2} = 1 + \frac{1}{2}$

$\frac{1}{2} = 0 + \frac{1}{2}$

$(30)_{10} = 11110$

$(0.625)_{10} \rightarrow 0.625 \times 2 = 1.250$

$0.250 \times 2 = 0.50$

$0.50 \times 2 = 1.00$

$0.00 \times 2 = 0.00$

$0.00 \times 2 = 0.00$

$(0.625)_{10} = (0.10100)_2$

$(30.625)_{10} = (11110.101)_2$

7) Express $(50)_{10}$ as a Hexadecimal number. Show all your steps.

$(50)_{10} \rightarrow$

$\frac{50}{2} = 25 + \frac{0}{2}$

$\frac{25}{2} = 12 + \frac{1}{2}$

$\frac{12}{2} = 6 + \frac{0}{2}$

$\frac{6}{2} = 3 + \frac{0}{2}$

$\frac{3}{2} = 1 + \frac{1}{2}$

$\frac{1}{2} = 0 + \frac{1}{2}$

$(50)_{10} = (\underbrace{0011}_{3}\underbrace{0010}_{2})_2 = (32)_{16}$

8) Represent $(20)_{10}$ as an octal number. Show all your steps.

$(20)_{10} \rightarrow$

$\frac{20}{2} = 10 + \frac{0}{2}$

$\frac{10}{2} = 5 + \frac{0}{2}$

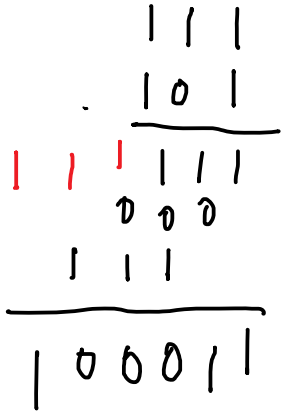
$\frac{5}{2} = 2 + \frac{1}{2}$

$\frac{2}{2} = 1 + \frac{0}{2}$

$\frac{1}{2} = 0 + \frac{1}{2}$

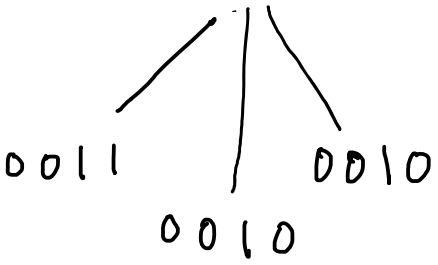
$(20)_{10} = (\underbrace{010}_{2}\underbrace{100}_{4})_2 = (24)_8$

9) Multiply $(111)_2$ by $(101)_2$ by using the rules of binary number multiplication. Convert your result to decimal numbers. Show all your steps.



$$(100011)_2 = 2^5 + 2^1 + 2^0 = 32 + 2 + 1 = (35)_{10}$$

10) Express $(322)_{10}$ as a BCD encoded number



$$(322)_{10} = (0011\ 0010\ 0010)_{BCD}$$