HW1 Solutions ECE2000 Au 2015

Lectures Covered: Lesson1 - Lesson4

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

Late HWs will not be accepted. Lecture Students: turn in your HW in class. Recitation students: turn in your HW at the ECE Office Front Desk. 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 section. You will lose an additional point if you fail to provide these details

Your Last Name________________________________________ Your First Name________________________________________

1. Lecture Student ___________ or Recitation Student__________ (check one)
2. If Recitation then fill out the following
   Name of recitation instruction________________________ Date/time of recitation________________

Problems start from next page. Each problem is worth 1 point.
1) The bits of (-20)\textsubscript{10} are to be placed in a 16 bit register (using 2's compliment representation). Show all the 16 bits in this register.

\((-20)_{10} \rightarrow 11101100\)

2) The bits of (20)\textsubscript{10} are to be placed in a 16 bit register (using 2's compliment representation). Show all the 16 bits in this register.

\((20)_{10} \rightarrow 00010100\)

3) Let \(a=(1110000)_{2}\) and \(b=(-1)_{10}\), assume that we are using signed binary numbers (2's compliment representation) stored in 8 bit registers. Let \(c = a + b\).

i) Show all the binary bits of \(c\)

ii) By using the argument based on "carry out of signed bit" and "carry into the signed bit" determine if there is overflow.

(carry out of signed bit) \(\rightarrow\) carry into signed bit

\((-1)_{10} \rightarrow 11111111\)
\(c \rightarrow 11011111\)

carry out of signed bit is equal to carry into signed bit : no overflow
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. Show all the binary bits of \( c \)

ii. By using the argument based on "carry out of signed bit" and "carry into the signed bit" determine if there is overflow.

\[
\begin{align*}
\text{2's complement of } b &= (11111111)_2 \\
\text{2's complement of } (11111111) &= (00000001)_2 \\
a - b &= 11100000 \\
&\quad + 00000001 \\
&\quad \underline{\text{11100001}} \quad \begin{array}{c} \text{carry out of sign bit} = 0 \\
\text{carry into sign bit} = 0 \end{array} \quad \text{no overflow}
\end{align*}
\]

5) Express \((10000000)_2\) as a decimal number,

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

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

2'compliment: See page 16 lesson 3

\((10000000)\) is the maximum magnitude negative number stored in 8 bits

\((10000000)_2 = -128\)

Unsigned representation:

\((10000000)_2 = 2^7 = 128\)
6) Express \((21.678)_{10}\) as a binary number

**Integer part:**
\[
\frac{21}{2} = 10 + \frac{1}{2} \\
\frac{10}{2} = 5 + \frac{0}{2} \\
\frac{5}{2} = 2 + \frac{1}{2} \\
\frac{2}{2} = 1 + 0 \\
\frac{1}{2} = 0 + 1 \\
\rightarrow 10101
\]

**Fractional part:**
\[
0.678 \times 2 = 1.356 \\
0.356 \times 2 = 0.712 \Rightarrow 0.1010 \ldots \\
0.712 \times 2 = 1.424 \\
0.424 \times 2 = 0.848
\]
\[
(21.678)_{10} = 1010.1010
\]

*Truncate based on the accuracy you want.*
7) Express \((234)_{10}\) as a Hexadecimal number

\[
(234)_{10} = (1110.1010)_{2} = (EA)_{16}
\]

8) The bits 11100010 are stored in an 8 bit register to represent a signed (2's compliment representation) binary number. This number is divided by 8 and stored in another 8 bit register. Show all the bits in this register.

\[8 = 2^3\]

Shift binary point by 3 digits to the left, discard the fractional part and pad by 3 1's on the left

Padding 11111100 discard fractional part
9) The bits 1111010 are stored in an 8 bit register to represent a signed (2's compliment representation) binary number. This number is multiplied by 8 and stored in another 8 bit register. Show all the bits in this register.

\[ 8 = 2^3 \]
\[ 1111010 \times 2^3 = 11111010000 \]

*add three 0's*

*discard 3 1's*

*These are only padding*

**answer**

\[ 01010000 \]

10) Express \( (234)_{10} \) as a BCD encoded number

\[ (2\ 3\ 4)_{10} \]

\[ 0010 \quad 0011 \]

\[ (234)_{10} = (0010\ 0011\ 0100)_{\text{BCD}} \]