EE 2720, Spring 2011

Homework # 1 solutions

EE 2720

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Problem 1: $10011101.011_2 = 1\times2^7 + 0\times2^6 + 0\times2^5 + 1\times2^4 + 1\times2^3 + 1\times2^2 + 0\times2^1 + 1\times2^0 + 0\times2^{-1} + 1\times2^{-2} + 1\times2^{-3} = 128 + 16 + 8 + 4 + 1 + 0.25 + 0.125 = 157.375_{10}$

Problem 2: The length of the integer part is 10 bits (not a multiple of 3) so we put two zeros at its left to make it a multiple of 3. The length of the fractional part is 2 bits so we put a zero at its right to make it a multiple of 3. We now have:

$$001\ 010\ 011\ 101 . 110_2 = 1235.6_8$$

Problem 3: $4567.75_8 =$

100101110111.111101_2

Problem 4: Neither the length of the integer part nor the length of the fractional part are multiples of 4.

NEXT PAGE

EE 2720

Homework # 1 solutions cont.

Problem 4 cont: we therefore put two zeros at the left of the integer part and two zeros at the right of the fractional part to make their lengths multiples of 4. We now have:

$0010\ 1001\ 1101.1100_2 = 29D.C_{16}$

Problem 5: $58E.A6_{16} =$

$010110001110.1010\ 0110_2$

Problem 6: Integer part or 173

	Quotient	Remainder
173/2	86	1 LSB
86/2	43	0
43/2	21	1
21/2	10	1
10/2	5	0
5/2	2	1
2/2	1	0
1/2	0	1 MSB

⇒ NEXT PAGE ⇒

EE 2720

Homework #1 sols. cont.

Problem 6 cont. Fractional part 0.625

	Fract. part	Integer part
$0.625 \times 2 = 1.25$	0.25	1 MSB
$0.25 \times 2 = 0.5$	0.5	0
$0.5 \times 2 = 1.0$	0	1 LSB

So $173.625_{10} = 10101101.101_2$

Problem 7:

	fract. part	Integer part
$0.7 \times 2 = 1.4$	0.4	1 MSB
$0.4 \times 2 = 0.8$	0.8	0
$0.8 \times 2 = 1.6$	0.6	1
$0.6 \times 2 = 1.2$	0.2	1
$0.2 \times 2 = 0.4$	0.4	0
$0.4 \times 2 = 0.8$	0.8	0
$0.8 \times 2 = 1.6$	0.6	1
$0.6 \times 2 = 1.2$	0.2	1
$0.2 \times 2 = 0.4$	0.4	0

Process doesn't terminate. what you get is :

NEXT PAGE

Problem 7 cont.

$0.7_{10} = 0.1\,\underbrace{0110}\,\underbrace{0110}\,\underbrace{0110}\cdots{}_2$

Above is a binary fraction with infinite number of bits.

Problem 8: $DR = [0 \quad 2^{10}-1] = [0 \quad 1023]$.

Problem 9:

$$\begin{array}{rll} & 0\,000100 & \text{carry} \\ & 101011 & \\ +) & 010010 & \\ \hline \text{carry out} \rightarrow & 0\,111101 & \text{sum} \end{array}$$

Here overal carry out is $C=0$, so overflow didn't occur. The correct result is $X+Y = 111101_2 = 61_{10}$. Here the Dynamic range is $DR = [0 \quad 63]$ and $61 < 63$.

Problem 10: As said in problem 9,

$DR = [0 \quad 63]$

NEXT PAGE

EE 2720

HW #1 sols. cont.

Problem 10 cont: The addition follows

$$
\begin{array}{rrl}
 & 1\ 111110 & \text{carry} \\
 & 101111 & \\
+) & 010111 & \\
\hline
\text{carry out} \rightarrow & 1\ 000110 & \text{sum}
\end{array}
$$

Here overal carry out is $c = 1$, so overflow occured. The obtained result is $X+Y = 1000110_2 = 70_{10}$ and $70 > 63$; (70 is outside the Dynamic Range (DR).

Problem 11: The Dynamic Range is

$DR = [-(2^{6-1}-1)\quad +(2^{6-1}-1)] = [-31\quad +31]$

Problem 12: The first way is: $r=10$, $n=5$; so 10's complement of $35865 = 10^5 - 35865 = 64135$. For the second way we have: $r=10$ so $r-1=9$. The digit 3 becomes $9-3=6$, the digit 5 becomes $9-5=4$, the digit 8 becomes $9-8=1$, the digit 6 becomes $9-6=3$, the digit 5 becomes $9-5=4$. Thus 10's compl. of $35865 = 64134+1 = 64135$.

EE 2720

HW #1 sols: cont.

Problem 13: $DR = [-2^{8-1} + (2^{8-1}-1)] =$

$[-128 \quad +127]$.

Problem 14: $11011011_2 = -2^7 \times 1 + 1 \times 2^6$

$+ 0 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 =$

$-128 + 64 + 16 + 8 + 2 + 1 = -37_{10}$.

Problem 15:

```
   11011010
      ↓ complement bits
   00100101
+)        1
   --------
   00100110
```

Problem 16:

```
        1 ← initial Cin of 1
    101010
+)  111010
   -------
  1 100101
```

ignore → 1

$\underbrace{100101}$ → $X - Y = 100101_2 = -27_{10}$.