EE 2720, Fall 2010

Homework #1 solutions

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Problem 1: $10111010.011_2 = 1\times2^7+0\times2^6+1\times2^5+1\times2^4+1\times2^3+0\times2^2+1\times2^1+0\times2^0+0\times2^{-1}+1\times2^{-2}+1\times2^{-3} = 128+32+16+8+2+0.25+0.125 = 186.375_{10}$

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:

$001\ 101\ 010\ 011.\ 110_2 = 1523.6_8$

Problem 3: $6437.37_8 =$

$110\ 100\ 011\ 111.\ 011\ 111_2$

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

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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:

$0011\ 0101\ 0011.1100_2 = 353.C_{16}$

Problem 5: $97D.B8_{16} =$

$1001\ 0111\ 1101.1011\ 1000_2$

Problem 6: Integer part of 153

	Quotient	Remainder
153/2	76	1 LSB
76/2	38	0
38/2	19	0
19/2	9	1
9/2	4	1
4/2	2	0
2/2	1	0
1/2	0	1 MSB

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Problem 6 cont: Fractional part 0.75

	Fract. part	Integer part
$0.75 \times 2 = 1.5$	0.5	1 MSB
$0.5 \times 2 = 1$	0	1 LSB

So $153.75_{10} = 10011001.11_2$

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. ~~You get~~ what you get is:

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Problem 7 cont:

$0.7_{10} = 0.1011001100110\ldots_2$

Above is a binary fraction with infinite number of bits.

Problem 8: $DR = [0 \quad 2^9 - 1] = [0 \quad 511]$.

Problem 9:

```
  0 000100      carry
    101011
+)  010010
-------------
  0 111101      sum
```

carry out ↗

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,

$DR = [0 \quad 63]$

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Problem 10 cont: The addition follows

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

Here overall carry out is $c=1$, so overflow occured. The obtained result is $X+Y = 1000110_2 = 70_{10}$ and $70 > 63$

Problem 11: The Dynamic Range is

$$DR = [-(2^{8-1}-1) \quad +(2^{8-1}-1)] = [-127 \; +127]$$

Problem 12: The first way is: $r=10$, $n=5$; So 10's complement of $46957 = 10^5 - 46957 = 53043$. For the second way we have: $r=10 \Rightarrow r-1=9$. The digit 4 becomes $9-4=5$, the digit 6 becomes $9-6=3$, the digit 9 becomes $9-9=0$, the digit 5 becomes $9-5=4$ and the digit 7 becomes $9-7=2$

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Problem 12 cont: Thus

10's complement of 46957 = 53042 + 1

= 53043

Problem 13: DR = $[-2^{10-1} + (2^{10-1} - 1)]$

= [−512 +511]

Problem 14: $10100110_2 = -2^7 \times 1 + 2^5 + 2^2 + 2^1$

$= -128 + 32 + 4 + 2 = -90_{10}$

Problem 15: 10101010

↓ complement bits

01010101

+) 1

01010110

Problem 16:

1 ← initial Cin of 1

101001

111001

1 100011

ignore ↗

↳ X − Y = $100011_2 = -29_{10}$