

EE 2720, Fall 2011

Homework #1 solutions

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

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:

$$\underbrace{001}_{\text{3 bits}} \underbrace{1010}_{\text{4 bits}} \underbrace{1011}_{\text{4 bits}} \underbrace{110}_{\text{3 bits}}_2 = 1523.6_8$$

Problem 3: $6437.37_8 =$

$$110100011111.011111_2$$

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. ~~What you get~~
what you get is:

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Problem 7 cont:

$$0.7_{10} = 0.\underbrace{1011001100110}_{\dots}_2$$

Above is a binary fraction with infinite number of bits.

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

Problem 9:

$$\begin{array}{r} 000100 \quad \text{carry} \\ 101011 \\ +) 010010 \\ \hline 0111101 \quad \text{sum} \end{array}$$

carry out \rightarrow

Here overall 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 $DR = [0, 63]$ and $61 < 63$.

Problem 10: As said in problem 9,

$$DR = [0, 63]$$

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Homework #1 solutions cont.Problem 10 cont: The addition follows

$$\begin{array}{r} 1 \quad 111110 \quad \text{carry} \\ 101111 \\ +) 010111 \\ \hline \end{array}$$

carry out $\rightarrow 1000110$ sum

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

Problem 11: The Dynamic Range is

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

Problem 12: The first way is: $r=10, n=5$;

So 10^5 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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$$10's \text{ complement of } 46957 = 53042 + 1 \\ = 53043$$

$$\text{Problem 13: DR} = [-2^{10-1} + (2^{10-1} - 1)] \\ = [-512 + 511]$$

$$\text{Problem 14: } 10100110_2 = -2^7 \times 1 + 2^5 + 2^2 + 2^1 \\ = -128 + 32 + 4 + 2 = -90_{10}$$

$$\text{Problem 15: } \begin{array}{r} 10101010 \\ \downarrow \text{complement bits} \\ 01010101 \\ +) 1 \\ \hline 01010110 \end{array}$$

Problem 16:

$$\begin{array}{r} 101001 \\ 111001 \\ \hline 1 100011 \\ \text{ignore} \rightarrow \end{array} \quad \begin{array}{l} 1 \leftarrow \text{initia} \text{ cin of } 1 \\ \rightarrow X - Y = 100011_2 = -29_{10} \end{array}$$