

EE 2720, Spring 2011
Homework # 1 solutions

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

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:

$$\underbrace{001}_{3} \underbrace{010}_{3} \underbrace{011}_{3} \underbrace{101}_{3} . \underbrace{110}_{3} \underbrace{0}_{3} \underbrace{2}_{3} = 1235.6_8$$

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.

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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:

$$\begin{array}{l} 0010 \ 1001 \ 1101 \cdot 1100_2 = 29D \cdot C_{16} \\ \underline{\quad} \quad \underline{\quad} \end{array}$$

Problem 5: $58E \cdot A6_{16} =$

$$010110001110 \cdot 10100110_2$$

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

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Problem 6 cont. Fractional part 0.625

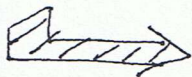

	Fract. part	Integer part
$0.625 \times 2 = 1.25$	0.25	1 MSB
$0.25 \times 2 = 0.5$	0.5	0
$0.5 \times 2 = 1.0$	0	1 LSB

$$\text{So } 173.625_{10} = 10101101.101_2$$

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 :

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Problem 7 cont.

$$0.7_{10} = 0.1 \underbrace{0110} \underbrace{0110} \underbrace{0110} \dots_2$$

Above is a binary fraction with infinite number of bits.

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

Problem 9:

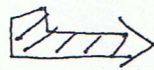
$$\begin{array}{r}
 0 \ 000100 \text{ carry} \\
 101011 \\
 +) 010010 \\
 \hline
 \text{carry out} \rightarrow 0 \ 111101 \text{ sum}
 \end{array}$$

Here overall carry out is $C=0$, so overflow didn't occur. The correct result is

$$X+Y = 111101_2 = 61_{10}. \text{ Here the Dynamic range is } DR = [0 \ 63] \text{ and } 61 < 63.$$

Problem 10: As said in problem 9,

$$DR = [0 \ 63]$$



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Problem 10 cont: The addition follows

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

Here overall carry out is $C=1$, so overflow occurred. 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

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

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 $35865 = 64134+1 = 64135$.

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Problem 13: $DR = [-2^{8-1} + (2^{8-1} - 1)] =$
 $[-128 + 127]$.

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
 \oplus
 00100101

Problem 16:

101010 ← initial cin of 1
 $\oplus 111010$
 $\hline 1100101$
 ignore ↑
 $\hookrightarrow X - Y = 100101_2 =$
 -27_{10} .