

EE 2720, Spring 2012

Homework #1 solution

EE 2729 HW #1 solution

(1)

Problem 1: $11010101.011_2 =$

$$1 \times 2^7 + 1 \times 2^6 + 0 \times 2^5 + 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 + 0 \times 2^{-1} + 1 \times 2^{-2} + 1 \times 2^{-3} = 213.375_{10}$$

Problem 2: The length of the integer part is 10 bits 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:

$$\begin{array}{ccccccc} 000 & 111 & 010 & 101 & . & 110 & \\ \underbrace{\hspace{1em}} & \underbrace{\hspace{1em}} & \underbrace{\hspace{1em}} & \underbrace{\hspace{1em}} & & \underbrace{\hspace{1em}} & \\ 0 & 7 & 2 & 5 & . & 6 & \end{array}$$

Problem 3: $7645.32_8 =$

$$111110100101.011010_2$$

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

Pr. 4 cont: we now have:

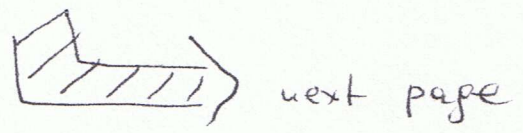
$$\begin{array}{cccc} \underbrace{0001} & \underbrace{1101} & \underbrace{0101} & \underbrace{1100} \\ \downarrow & \downarrow & \downarrow & \downarrow \\ 1 & D & 5 & C_{16} \end{array}$$

Problem 5: $7FA \cdot B9_{16} =$

$$011111111010 \cdot 10111001_2$$

Pr 6: Integer part of 139

	Quotient	Remainder
$139/2$	69	1 LSB
$69/2$	34	1
$34/2$	17	0
$17/2$	8	1
$8/2$	4	0
$4/2$	2	0
$2/2$	1	0
$1/2$	0	1 MSB



Pr 6 cont:

	frac. part	Integer part
$0.375 \times 2 = 0.75$	0.75	0 MSB
$0.75 \times 2 = 1.5$	0.5	1
$0.5 \times 2 = 1.0$	0	1 LSB

So $139.375_{10} = 10001011.011_2$

Problem 7:

	frac. 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 we get is:

$0.7_{10} = 0.1011001100110 \dots_2$

Above is a binary fraction with infinite number of bits

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

Problem 9:

$$\begin{array}{r}
 0000100 \quad \text{cmy} \\
 \hline
 101011 \\
 +) 010010 \\
 \hline
 0111101 \quad \text{sum}
 \end{array}$$

cmy out \rightarrow

Here overall cmy out is $c=0$, so overflow didn't occur. The correct result is $111101_2 = 61_{10}$.
 Here the dynamic range is $DR = [0 \ 63]$ and $61 < 63$.

Problem 10: As said in prob 9, $DR = [0 \ 63]$.

$$\begin{array}{r}
 111110 \quad \text{cmy} \\
 \hline
 101111 \\
 +) 010111 \\
 \hline
 1000110 \quad \text{sum}
 \end{array}$$

cmy out \rightarrow

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

Problem 11: $DR = \left[-(2^{10-1} - 1) \quad +(2^{10-1} - 1) \right]$

$$= \left[-(2^9 - 1) \quad 2^9 - 1 \right] = \left[-511 \quad 511 \right]$$

Problem 12: $DR = \left[-2^{8-1} \quad 2^{8-1} - 1 \right] = \left[-2^7 \quad 2^7 - 1 \right]$

$$= \left[-128 \quad 127 \right]$$

Problem 13: $10011101_2 = -2^7 \times 1 + 2^4 + 2^3 + 2^2 + 2^0 =$

$$-128 + 16 + 8 + 4 + 1 = -99_{10}$$

Prob. 14:
$$\begin{array}{r} 01010101 \\ \downarrow \text{complement bits} \\ 10101010 \end{array}$$

$$\begin{array}{r} +) \quad \quad \quad 1 \\ \hline 11010101 \end{array}$$

Pr 15:

$$\begin{array}{r} 101001 \\ 100101 \\ \hline 111001 \\ \hline 110001 \end{array}$$

← initial carry in of 1

ignore → $X - Y = 100011_2 = -29_{10}$