EE 2720, Spring 05

Solutions of Homework #1

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Problem 1: $1010111011.111 =$

$2^9 + 2^7 + 2^5 + 2^4 + 2^3 + 2^1 + 2^0 + 2^{-1} + 2^{-2} + 2^{-3} =$

$512 + 128 + 32 + 16 + 8 + 2 + 1 + 0.5 + 0.25 + 0.125$

$= 699.875_{10}$

Problem 2: $67.4_8 = 6 \times 8^1 + 7 \times 8^0 + 4 \times 8^{-1} =$

$6 \times 8 + 7 \times 1 + \frac{4}{8} = 55.5_{10}$

Problem 3: $8DF.8_{16} = 8 \times 16^2 + 13 \times 16^1 + 15 \times 16^0$

$+ 8 \times 16^{-1} = 2048 + 208 + 15 + \frac{8}{16} = 2271.5_{10}$

Problem 4: $3432.1_5 = 3 \times 5^3 + 4 \times 5^2 + 3 \times 5^1 + 2 \times 5^0$

$+ 1 \times 5^{-1} = 375 + 100 + 15 + 2 + 0.2 = 492.2_{10}$

Problem 5: we put zeroes at the left of the integer part and at the right of the fractional part to make both lengths of integer and fractional part multiples of 3. We then have

$\underbrace{010}\ \underbrace{111}\ \underbrace{010}\ \underbrace{111}.\ \underbrace{100}_2 = 2727.4_8$

Problem 6: $7654.56_8 =$

$= 111\ 110\ 101\ 100.101\ 110_2$

Problem 7: We put zeroes at the left of the integer part and at the right of the fractional part to make both lengths of integer and fractional part multiples of 4. We then have

$$\underbrace{0101}\ \underbrace{1101}\ \underbrace{0111}\,.\,\underbrace{1000}_2 = 5D7.8_{16}$$

Problem 8: $A7B8E.F6_{16} =$

$1010\ 0111\ 1011\ 1000\ 1110\,.\,1111\ 0110_2$

Problem 9: The procedure is simple. Separate the bits of the binary number into groups of two bits and replace each group with the corresponding radix-4 digit; (the radix-4 digits are 0, 1, 2, 3). Make both lengths of integer and fractional parts even. We then have: $\underbrace{01}\underbrace{11}\underbrace{01}\underbrace{01}\underbrace{10}\,.\,\underbrace{10}\underbrace{10}_2 =$

$= 13112.22_4$

Problem 10: Integer part or 567

	Quotient	Remainder
$567/2$	283	1 LSB
$283/2$	141	1
$141/2$	70	1
$70/2$	35	0
$35/2$	17	1
$17/2$	8	1
$8/2$	4	0
$4/2$	2	0
$2/2$	1	0
$1/2$	0	1 MSB

Fractional part or 0.625

	Fractional part	Integer part
$0.625 \times 2 = 1.25$	0.25	1 MSB
$0.25 \times 2 = 0.5$	0.5	0
$0.5 \times 2 = 1.0$	0.0	1 LSB

So $567.625_{10} = 1000110111.101_2$

Problem 11:

	Fractional 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 does not terminate. What you get is

$0.7_{10} = 1\,0\underbrace{11}0\,0\underbrace{11}0\,0\underbrace{11}0\ldots_2$. It is a binary fraction with infinite number of bits

Problem 12: Integer part or 1587

	Quotient	Remainder
1587/8	198	3 LSD
198/8	24	6
24/8	3	0
3/8	0	3 MSD

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Problem 12 cont: Fractional part or 0.125

	Fractional part	Integer part
$0.125 \times 8 = 1.0$	0.0	1 MSD

So $1587.125_{10} = 3063.1_8$

Double check if you want. $3063.1_8 =$

$$= 3 \times 8^3 + 6 \times 8 + 3 + \frac{1}{8} = 1536 + 48 + 3 + 0.125$$

$$= 1587.125_{10}$$

Problem 13: Integer part or 2958

	Quotient	Remainder
$2958/16$	184	14 LSD
$184/16$	11	8
$11/16$	0	11 MSD

Fractional part or 0.625

	Fractional part	Integer part
$0.625 \times 16 = 10.00$	0.0	10 MSD

So $2958.625_{10} = B8E.A_{16}$

Double check if you want. $B8E.A_{16} = 11 \times 16^2 + 8 \times 16$

$$+ 14 + \frac{10}{16} = 2816 + 128 + 14 + 0.625 = 2958.625_{10}$$

Problem 14: I first convert 231.3_4 into a decimal number. $231.3_4 = 2 \times 4^2 + 3 \times 4 + 1 + 3 \times 4^{-1}$
$= 32 + 12 + 1 + \frac{3}{4} = 45.75_{10}$. I now convert 45.75_{10} into a radix-7 number.

Integer part or 45

	Quotient	Remainder
45/7	6	3 LSD
6/7	0	6 MSD

Fractional part or 0.75

	Fractional part	Integer part
$0.75 \times 7 = 5.25$	0.25	5 MSD
$0.25 \times 7 = 1.75$	0.75	1
$0.75 \times 7 = 5.25$	0.25	5
$0.25 \times 7 = 1.75$	0.75	1

The same fractional digits keep repeated over and over again. The process does not terminate. What you get is $231.3_4 = 63.51515151\ldots_7$. The fractional part of the radix-7 number has infinite number of digits.

Problem 15: $DR = [0 \quad 2^9 - 1] = [0 \quad 511]$.

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Problem 16: The Dynamic Range (DR) of an 8-bit binary unsigned system is $DR = [0 \quad 2^8-1] = [0 \quad 255]$. The addition is

$$
\begin{array}{rl}
1\ \underline{11111100} & \text{carry} \\
11101111 & \\
+)\ \underline{01011010} & \\
1\,01001001 & \text{sum}
\end{array}
$$

Here overal carry out is $c=1 \Rightarrow$ overflow occured. The obtained result is $X+Y = 101001001_2 = 329_{10}$ which is outside the DR. Just see that $329 > 255 \Rightarrow$ overflow.

Problem 17: As we said in pr. 16 $DR = [0 \quad 255]$.

The addition is

$$
\begin{array}{rl}
0\ \underline{00011110} & \text{carry} \\
10101101 & \\
+)\ \underline{01001111} & \\
0\,11111100 & \text{sum}
\end{array}
$$

Here overal carry out is $c=0 \Rightarrow$ no overflow. The result is $X+Y = 11111100_2 = 252_{10}$ which is within the DR. Just see that $252 < 255$.