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 1004-3383-46  
 EE 101 TTh lecture  
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 Due Tuesday, January 28, 2014  
 Homework #1

1.

a.  $110\ 0101.1001_2 = 145.44_8 = 0x65.9_{16} = 101.5625_{10}$

b.  $0x1A9.D_{16} = 651.64_8 = 1\ 1010\ 1001.1101_2 = 425.8125_{10}$

c.  $612_8 = 0x18A_{16} = 1\ 1000\ 1010_2 = 394_{10}$

2.

a.

$$57.8125 = 57 + 0.8125$$

$$57 = 1 + 2 \times 28$$

$$28 = 0 + 2 \times 14$$

$$14 = 0 + 2 \times 7$$

$$7 = 1 + 2 \times 3$$

$$3 = 1 + 2 \times 1$$

$$1 = 1 + 2 \times 0$$

$$57_{10} = 11\ 1001_2$$

$$0.8125 \times 2 = 1.625 = 1 + 0.625$$

$$0.625 \times 2 = 1.25 = 1 + 0.25$$

$$0.25 \times 2 = 0.5 = 0 + 0.5$$

$$0.5 \times 2 = 1 = 1 + 0$$

$$0.8125_{10} = 0.1101_2$$

$$57.8125_{10} = 57_{10} + 0.8125_{10} = 11\ 1001.1101_2$$

b.

$$1237.625 = 1237 + 0.625$$

$$1237 = 5 + 8 \times 154$$

$$154 = 2 + 8 \times 19$$

$$19 = 3 + 8 \times 2$$

$$2 = 2 + 8 \times 0$$

$$1237_{10} = 2325_8$$

$$0.625 \times 8 = 5 = 5 + 0$$

$$0.625_{10} = 0.5_8$$

$$1237.625_{10} = 1237_{10} + 0.625_{10} = 2325.5_8$$

c.

$$\begin{aligned}
91.64 &= 91 + 0.64 \\
91 &= 1 + 5 \times 18 \\
18 &= 3 + 5 \times 3 \\
3 &= 3 + 5 \times 0 \\
91_{10} &= 331_5 \\
0.64 \times 5 &= 3.2 = 3 + 0.2 \\
0.2 \times 5 &= 1 = 1 + 0 \\
0.64_{10} &= 0.31_5 \\
91.64_{10} &= 91_{10} + 0.64_{10} = 331.31_5
\end{aligned}$$

3.

a.  $5316.64_8 = 1010\ 1100\ 1110.1101_2 = 0xACE.D_{16}$

b.  $0xFEE.DAB_{16} = 1111\ 1110\ 1110\ 1101.1010\ 1011\ 111_2 = 17\ 7355.5276_8$

4.

a. The maximum unsigned integer that can be represented by a 4 digits decimal code is  $9999_{10}$ .  $\lceil \log_2(9999 + 1) \rceil = 14$  bits are required to represent  $9999_{10}$  in binary.

b.  $\lceil \log_2(2014 + 1) \rceil = 11$  bits are required to represent  $2014_{10}$  in binary.

5.

a.  $10110_2 + 111_2 = 11101_2$

$$\begin{array}{r}
\phantom{+)} \phantom{1} \phantom{0} \phantom{1} \phantom{1} \phantom{0} \\
\phantom{+)} \phantom{1} \phantom{0} \phantom{1} \phantom{1} \phantom{0} \\
+ ) \phantom{1} \phantom{0} \phantom{1} \phantom{1} \phantom{0} \phantom{1} \\
\hline
\phantom{+)} \phantom{1} \phantom{0} \phantom{1} \phantom{1} \phantom{0} \phantom{1}
\end{array}$$

b.  $11001_2 - 10111_2 = 10_2$

$$\begin{array}{r}
\phantom{-)} \phantom{1} \phantom{1} \phantom{0} \phantom{0} \phantom{1} \\
\phantom{-)} \phantom{1} \phantom{1} \phantom{0} \phantom{0} \phantom{1} \\
- ) \phantom{1} \phantom{0} \phantom{1} \phantom{1} \phantom{1} \\
\hline
\phantom{-)} \phantom{1} \phantom{0}
\end{array}$$

c.  $1101_2 \times 1111_2 = 11000011_2$

$$\begin{array}{r}
\phantom{\times)} \phantom{1} \phantom{1} \phantom{0} \phantom{0} \phantom{1} \phantom{1} \\
\phantom{\times)} \phantom{1} \phantom{1} \phantom{0} \phantom{0} \phantom{1} \phantom{1} \\
\times ) \phantom{1} \phantom{1} \phantom{0} \phantom{0} \phantom{1} \phantom{1} \\
\hline
\phantom{\times)} \phantom{1} \phantom{1} \phantom{0} \phantom{0} \phantom{1} \phantom{1} \\
\phantom{\times)} \phantom{1} \phantom{1} \phantom{0} \phantom{0} \phantom{1} \phantom{1} \\
\phantom{\times)} \phantom{1} \phantom{1} \phantom{0} \phantom{0} \phantom{1} \phantom{1} \\
\phantom{\times)} \phantom{1} \phantom{1} \phantom{0} \phantom{0} \phantom{1} \phantom{1} \\
+ ) \phantom{1} \phantom{1} \phantom{0} \phantom{0} \phantom{1} \phantom{1} \\
\hline
\phantom{\times)} \phantom{1} \phantom{1} \phantom{0} \phantom{0} \phantom{1} \phantom{1}
\end{array}$$

d.  $11111_2 + 11111_2 = 111110_2$

$$\begin{array}{r}
\phantom{+)} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \\
\phantom{+)} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \\
+ ) \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \\
\hline
\phantom{+)} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{1} \phantom{0}
\end{array}$$

6.

a.  $3_{10}x^1 + 5_{10} = 26_{10}$ ,  $x = 7_{10}$

b.  $1_{10}x^2 + 10_{10}x^1 + 5_{10} = 269_{10}$ ,  $(x + 22_{10})(x - 12_{10}) = 0$ ,  $x$  is a positive number,  $x = 12_{10}$

7.

a.  $1001\ 1011\ 0110_{\text{Excess-3}} = 0110\ 1000\ 0011_{\text{BCD}} = 683_{10} = 1010\ 1000\ 0101_{84-2-1}$

b.  $2\ 149_{10} = 0010\ 0001\ 0100\ 1001_{\text{BCD}} = 0110\ 0111\ 0100\ 1111_{84-2-1} = 0101\ 0100\ 0111\ 1100_{\text{Excess-3}}$

8.

$$3.14_{10} = 3_{10} + 0.14_{10}$$

$$3_{10} = 11_2$$

$$0.14 \times 2 = 0.28 = 0 + 0.28$$

$$0.28 \times 2 = 0.56 = 0 + 0.56$$

$$0.56 \times 2 = 1.12 = 1 + 0.12, \quad 0.001_2 = 0.125_{10} < 0.135_{10}$$

$$0.12 \times 2 = 0.24 = 0 + 0.24$$

$$0.24 \times 2 = 0.48 = 0 + 0.48$$

$$0.48 \times 2 = 0.96 = 0 + 0.96$$

$$0.96 \times 2 = 1.92 = 1 + 0.92, \quad 0.0010001_2 = 0.1328125_{10} < 0.135_{10}$$

$$0.92 \times 2 = 1.84 = 1 + 0.84, \quad 0.00100011_2 = 0.13671875_{10} > 0.135_{10}$$

$$3.14_{10} \simeq 11.00100011_2 \text{ within } -0.005 \text{ of error}$$

10 bits are required to represent  $3.14_{10}$  within -0.005 of error.

9.

a.  $0.1_{10} \simeq 0.000110011_2$

b.  $0.000110011_2 = 0.099609375_{10}$

c.  $36000(0.1 - 0.099609375) = 14.0625 \text{ sec}$

d. Around 100 hours.