Luke Yang
1004-3383-46
EE 101 TTh lecture
Dr. Satsuki Takahashi
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.

$$\begin{aligned}
57.8125 &= 57 + 0.8125 \\
57 &= 1 + 2 \times 28 \\
28 &= 0 + 2 \times 14 \\
14 &= 0 + 2 \times 7 \\
7 &= 1 + 2 \times 3 \\
3 &= 1 + 2 \times 1 \\
1 &= 1 + 2 \times 0 \\
57_{10} &= 11\ 1001_2 \\
0.8125 \times 2 = 1.625 &= 1 + 0.625 \\
0.625 \times 2 = 1.25 &= 1 + 0.25 \\
0.25 \times 2 = 0.5 &= 0 + 0.5 \\
0.5 \times 2 = 1 &= 1 + 0 \\
0.8125_{10} &= 0.1101_2 \\
57.8125_{10} &= 57_{10} + 0.8125_{10} = 11\ 1001.1101_2
\end{aligned}$$

b.

$$\begin{aligned}
1237.625 &= 1237 + 0.625 \\
1237 &= 5 + 8 \times 154 \\
154 &= 2 + 8 \times 19 \\
19 &= 3 + 8 \times 2 \\
2 &= 2 + 8 \times 0 \\
1237_{10} &= 2325_8 \\
0.625 \times 8 = 5 &= 5 + 0 \\
0.625_{10} &= 0.5_8 \\
1237.625_{10} &= 1237_{10} + 0.625_{10} = 2325.5_8
\end{aligned}$$

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. $5316.64_8 = 1010\ 1100\ 1110.1101_2 = \text{0xACE.D}_{16}$
b. $\text{0xFEED.ABE}_{16} = 1111\ 1110\ 1110\ 1101.1010\ 1011\ 111_2 = 17\ 7355.5276_8$
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. $10110_2 + 111_2 = 11101_2$

$$\begin{array}{llllll}
 & 1 & 0 & 1 & 1 & 0 \\
+) & & {}_1 & 1_1 & 1 & 1 \\
\hline
 & 1 & 1 & 1 & 0 & 1
\end{array}$$

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

$$\begin{array}{llllll}
 & 1 & 1^1 & 0^1 & 0 & 1 \\
-) & 1 & 0 & 1 & 1 & 1 \\
\hline
 & & & & 1 & 0
\end{array}$$

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

$$\begin{array}{lllllllll}
 & & & & & 1 & 1 & 0 & 1 \\
\times) & & & & & 1 & 1 & 1 & 1 \\
\hline
 & & & & & 1 & 1 & 0 & 1 \\
 & & & & 1 & 1 & 0 & 1 & \\
 & & & 1 & 1 & 0 & 1 & & \\
+) & & 1_1 & 1 & 0 & 1_1 & & & \\
\hline
 & 1 & 1 & 0 & 0 & 0 & 0 & 1 & 1
\end{array}$$

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

$$\begin{array}{lllllll}
 & & 1 & 1 & 1 & 1 & 1 \\
+) & {}_1 & 1_1 & 1_1 & 1_1 & 1_1 & 1 \\
\hline
 & 1 & 1 & 1 & 1 & 1 & 0
\end{array}$$

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.

$$
\begin{aligned}
3.14_{10} &= 3_{10} + 0.14_{10} \\
3_{10} &= 11_2 \\
0.14 \times 2 = 0.28 &= 0 + 0.28 \\
0.28 \times 2 = 0.56 &= 0 + 0.56 \\
0.56 \times 2 = 1.12 &= 1 + 0.12,\ \ 0.001_2 = 0.125_{10} < 0.135_{10} \\
0.12 \times 2 = 0.24 &= 0 + 0.24 \\
0.24 \times 2 = 0.48 &= 0 + 0.48 \\
0.48 \times 2 = 0.96 &= 0 + 0.96 \\
0.96 \times 2 = 1.92 &= 1 + 0.92,\ \ 0.0010001_2 = 0.132812\ 5_{10} < 0.135_{10} \\
0.92 \times 2 = 1.84 &= 1 + 0.84,\ \ 0.00100011_2 = 0.136718\ 75_{10} > 0.135_{10} \\
3.14_{10} &\simeq 11.00100011_2 \text{ within -0.005 of error}
\end{aligned}
$$

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. $36000(0.1 - 0.099609375) = 14.0625$ sec

d. Around 100 hours.