Homework 1

CSA

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Question 1: *Convert the following numbers from base 10 to 2 and then to 16:*

$$4_{(10)} \implies 0100_{(2)} \implies 4_{(16)}$$
$$10_{(10)} = 8 + 2 = 2^3 + 2^1 \implies 1010_{(2)} \implies A_{(16)}$$
$$15_{(10)} = 8 + 4 + 2 + 1 = 2^3 + 2^2 + 2^1 + 2^0 \implies 1111_{(2)} \implies F_{(16)}$$
$$32_{(10)} = 2^5 \implies 0010\ 0000_{(2)} \implies 20_{(16)}$$

Question 2: *Convert the following numbers from base 10 to 16 and then to 2:*

$$3_{(10)} \implies 3_{(16)} \implies 0011_{(2)}$$
$$11_{(10)} \implies B_{(16)} \implies 1011_{(2)}$$
$$16_{(10)} \implies 10_{(16)} \implies 10000_{(2)}$$
$$17_{(10)} \implies 11_{(16)} \implies 10001_{(2)}$$

Question 3: *Convert the following numbers from base 2 to 16:*

$$1010_{(2)} \implies A_{(16)}$$
$$0111_{(2)} \implies 7_{(16)}$$
$$1111_{(2)} \implies F_{(16)}$$
$$1000\ 1010_{(2)} \implies 8A_{(16)}$$
$$0001\ 1010\ 1111_{(2)} \implies 1AF_{(16)}$$

Question 4: *Convert the following numbers from base 16 to 2:*

$$
\begin{aligned}
3_{(16)} &\implies 0011_{(2)} \\
A_{(16)} &\implies 1010_{(2)} \\
F_{(16)} &\implies 15_{(10)} \implies 1111_{(2)} \\
2B_{(16)} &\implies 0010\ 1011_{(2)} \\
2F8_{(16)} &\implies 0010\ 1111\ 1000_{(2)}
\end{aligned}
$$

Question 5: *Compute the following expressions directly in base 2 (without converting to base 10):*

$$
\begin{aligned}
01_{(2)} + 01_{(2)} &= 10_{(2)} \\
10_{(2)} + 10_{(2)} &= 100_{(2)} \\
111_{(2)} + 001_{(2)} &= 1000_{(2)} \\
1010_{(2)} + 0001_{(2)} &= 1001_{(2)} \\
1000_{(2)} - 10_{(2)} &= 0110_{(2)}
\end{aligned}
$$

Question 6: *Compute the following expressions directly in base 16 (without converting to base 10):*

$$
\begin{aligned}
9_{(16)} + 1_{(16)} &= A_{(16)} \\
B_{(16)} + 2_{(16)} &= D_{(16)} \\
F_{(16)} + 1_{(16)} &= 10_{(16)} \\
10_{(16)} + A_{(16)} &= 1A_{(16)} \\
10_{(16)} - 2_{(16)} &= E_{(16)} \\
B_{(16)} - 3_{(16)} &= 8_{(16)}
\end{aligned}
$$

Question 7: *Check, using at least two of the complementary code rules, if:*

- 9A7D(16) and 7583(16) are complementary in a location of 2 bytes

$$
\left.
\begin{aligned}
9A7D_{(16)} &= 1001\ 1010\ 0111\ 1101_{(2)} \\
7583_{(16)} &= 0111\ 0101\ 1000\ 0011_{(2)}
\end{aligned}
\right\} \Rightarrow \text{They are } \textbf{not complementary} \text{ in a location of 2 bytes.}
$$

$$
10000_{(16)} - 09A7D_{(16)} = 6583_{(16)} \neq 7583_{(16)}
$$

- 000F095D(16) and FFF0F6A3(16) are complementary in a location of 4 bytes

$$10000000_{(16)} - 000F095D_{(16)} = 1FFF0F6A3_{(16)}$$

So they are **complementary** in a location of 4 bytes.

- 4BA1(16) and 5C93(16) are complementary in a location of 2 bytes

$$\left.\begin{array}{l} 4BA1_{(16)} = 0100\ 1011\ 1010\ 0001_{(2)} \\ 6C93_{(16)} = 0110\ 1100\ 1001\ 0011_{(2)} \end{array}\right\} \Rightarrow \text{They are } \textbf{not complementary} \text{ in a location of 2 bytes.}$$

- 7F(16) and 81(16) are complementary in a location of 1 byte

$$7F_{(16)} = 0111\ 1111_{(2)}$$

We invert the bits starting at the first 1 from right to left, to obtain the complementary:

$$1000\ 0001_{(2)}.$$

$$1000\ 0001_{(2)} = 81_{(16)}$$

So the bytes are **complementary**.

- 732A(16) and 4E58(16) are complementary in a location of 2 bytes

$$732A_{(16)} = 0111\ 0011\ 0010\ 1010_{(2)} \implies 1000\ 1100\ 1101\ 0110_{(2)} = 8CD6_{(16)} \neq 4E58_{(16)}$$

Question 8: *Write the 8-bits unsigned representation for the following numbers:*

$$8_{(10)} = 0000\ 1000_{(2)}$$
$$67 = 2^6 + 2^1 + 2^0 = 0100\ 0011_{(2)}$$
$$230 = 2^7 + 2^6 + 2^5 + 2^2 + 2^1 = 1110\ 0110_{(2)}$$

Question 9: *Write the 16-bits signed representation for the following numbers:*

$$6_{(10)} = 0000\ 0110_{(2)} \implies -6_{(2)} = 1111\ 1010_{(2)}$$
$$121_{(10)} = 0111\ 1001_{(2)} \implies -121_{(2)} = 1000\ 0111_{(2)}$$
$$70_{(10)} = 0100\ 0110_{(2)}$$