ECEN 2350 Spring 2017 Homework 1
Samuel Cuthbertson

---

1. *Convert the following decimal numbers into binary.*

   (a) $(30)_{10}$

$$
\begin{aligned}
30 \div 2 = 15 \quad & r0 \quad LSB \\
15 \div 2 = 7 \quad & r1 \\
7 \div 2 = 3 \quad & r1 \\
3 \div 2 = 1 \quad & r1 \\
1 \div 2 = 0 \quad & r1 \quad MSB \\
\Rightarrow (30)_{10} = & \boxed{\mathbf{(11110)_2}}
\end{aligned}
$$

   (b) $(110)_{10}$

$$
\begin{aligned}
110 \div 2 = 55 \quad & r0 \quad LSB \\
55 \div 2 = 27 \quad & r1 \\
27 \div 2 = 13 \quad & r1 \\
13 \div 2 = 6 \quad & r1 \\
6 \div 2 = 3 \quad & r0 \\
3 \div 2 = 1 \quad & r1 \\
1 \div 2 = 0 \quad & r1 \quad MSB \\
\Rightarrow (110)_{10} = & \boxed{\mathbf{(1101110)_2}}
\end{aligned}
$$

(d) $(500)_{10}$

$$
\begin{aligned}
500 \div 2 &= 250 && r0 && LSB \\
250 \div 2 &= 125 && r0 \\
125 \div 2 &= 62 && r1 \\
62 \div 2 &= 31 && r0 \\
31 \div 2 &= 15 && r1 \\
15 \div 2 &= 7 && r1 \\
7 \div 2 &= 3 && r1 \\
3 \div 2 &= 1 && r1 \\
1 \div 2 &= 0 && r1 && MSB \\
\Rightarrow (500)_{10} &= \boxed{\mathbf{(111110100)_2}}
\end{aligned}
$$

2. *Extend the conversion algorithm shown in Figure 1.6 of the book to convert the decimal number* $(857)_{10}$ *to hexadecimal.*

$$
\begin{aligned}
857 \div 16 &= 53 && r9 && LSB \\
53 \div 16 &= 3 && r5 \\
3 \div 16 &= 0 && r3 && MSB \\
\Rightarrow (857)_{10} &= \boxed{\mathbf{(359)_{16}}}
\end{aligned}
$$

3. *Convert the following binary numbers into hexadecimal and decimal using the method shown in Section 1.5.1*

   Note that $V(B) = \sum_{i=0}^{n-1} b_i * 2^i$. To convert to hex, we can take the value of a set of four bits and simply convert that decimal number to a single digit of hex.

   (a) $(11101001)_2$

$$
\begin{aligned}
(11101001)_2 &= (1*2^7 + 1*2^6 + 1*2^5 + 0*2^4 + 1*2^3 + 0*2^2 + 0*2^1 + 1*2^0)_{10} \\
(11101001)_2 &= (128 + 64 + 32 + 8 + 1)_{10} \\
(11101001)_2 &= \boxed{\mathbf{(233)_{10}}}
\end{aligned}
$$

And for Hexadecimal:

$(1110)_2 = (1 * 2^3 + 1 * 2^2 + 1 * 2^1 + 0 * 2^0)_{10}$ $(1001)_2 = (1 * 2^3 + 0 * 2^2 + 0 * 2^1 + 1 * 2^0)_{10}$
$(1110)_2 = (8 + 4 + 2)_{10}$ $(1001)_2 = (8 + 1)_{10}$
$(1110)_2 = (14)_{10} = (E)_{16}$ $(1001)_2 = (9)_{10} = (9)_{16}$
$\Rightarrow (11101001)_2 = \boxed{(\mathbf{E9})_{\mathbf{16}}}$

(b) $(1010101011)_2$

$$\begin{aligned}(1010101011)_2 &= (1 * 2^9 + 0 * 2^8 + 1 * 2^7 + 0 * 2^6 + 1 * 2^5 + \\ &\quad 0 * 2^4 + 1 * 2^3 + 0 * 2^2 + 1 * 2^1 + 1 * 2^0)_{10} \\ (1010101011)_2 &= (512 + 128 + 32 + 8 + 2 + 1)_{10} \\ (1010101011)_2 &= \boxed{(\mathbf{683})_{\mathbf{10}}}\end{aligned}$$

And for Hexadecimal:

$(10)_2 = (2)_{10}$ $(1010)_2 = (8 + 2)_{10}$ $(1011)_2 = (8 + 2 + 1)_{10}$
$(10)_2 = (2)_{10} = (2)_{16}$ $(1010)_2 = (10)_{10} = (A)_{16}$ $(1011)_2 = (11)_{10} = (B)_{16}$
$\Rightarrow (1010101011)_2 = \boxed{(\mathbf{2AB})_{\mathbf{16}}}$

(c) $(011001011111)_2$

$$\begin{aligned}(011001011111)_2 &= (0 * 2^{11} + 1 * 2^{10} + 1 * 2^9 + 0 * 2^8 + 0 * 2^7 + 1 * 2^6 + \\ &\quad 0 * 2^5 + 1 * 2^4 + 1 * 2^3 + 1 * 2^2 + 1 * 2^1 + 1 * 2^0)_{10} \\ (011001011111)_2 &= (1024 + 512 + 64 + 16 + 8 + 4 + 2 + 1)_{10} \\ (011001011111)_2 &= \boxed{(\mathbf{1631})_{\mathbf{10}}}\end{aligned}$$

And for Hexadecimal:

$(0110)_2 = (4 + 2)_{10}$ $(0101)_2 = (4 + 1)_{10}$ $(1111)_2 = (8 + 4 + 2 + 1)_{10}$
$(0110)_2 = (6)_{10} = (6)_{16}$ $(1010)_2 = (5)_{10} = (5)_{16}$ $(1011)_2 = (15)_{10} = (F)_{16}$
$\Rightarrow (011001011111)_2 = \boxed{(\mathbf{65F})_{\mathbf{16}}}$

4. *Given the circuit in the homework, answer the following:*

   (a) *Logical equation $H(F, D)$ in sum of products form*

   The circuit shows H to be D or F, which is written as:

   $$(F, D) = \boxed{\mathbf{D} + \mathbf{F}}$$

   (b) *Logical equation $G(A, B)$ in sum of products form*

   Since $G(A, B) = H(F, D)$, $F = AB$, and $D = \overline{B}$, we can substitute A and B in for F and D as shown:

   $$H(F, D) = D + F = G(A, B)$$
   $$\boxed{\overline{\mathbf{B}} + \mathbf{AB}} = G(A, B)$$