Homework 1

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Please excuse this atrocious attempt at LaTex. I have just begun learning and I am still unfamiliar with some of the scripts.

But after 500+ lines of code and many hours, I have decided that perhaps my way of writing LaTex is not the most effecient method to do homework.

Problem 1:

a) 11001001010110

1	1	0	0	1	0	0	1	0	1	0	1	1	0
2^{13}	2^{12}	0	0	2^9	0	0	2^6	0	2^4	0	2^2	2^1	0

$$2^{13} + 2^{12} + 2^9 + 2^6 + 2^4 + 2^2 + 2 = \boxed{12886}$$

b) 0001011110

0	0	0	1	0	1	1	1	1	0
0	0	0	2^6	0	2^4	2^3	2^2	2^1	0

$$2^6 + 2^4 + 2^3 + 2^2 + 2^1 = \boxed{94}$$

c) 101010110010

1	0	1	0	1	0	1	1	0	0	1	0
2^{11}	0	2^9	0	2^7	0	2^5	2^4	0	0	2^1	0

$$2^{11} + 2^9 + 2^7 + 2^5 + 2^4 + 2 = \boxed{2738}$$

Problem 2:

a) 823

Bit 0	$\frac{823}{2} = (2)411 + 1 \Rightarrow \quad 1$
Bit 1	$\frac{411}{2} = (2)205 + 1 \Rightarrow \quad 1$
Bit 2	$\frac{205}{2} = (2)102 + 1 \Rightarrow \quad 1$
Bit 3	$\frac{102}{2} = (2)51 + 0 \Rightarrow \quad 0$
Bit 4	$\frac{51}{2} = (2)25 + 1 \Rightarrow \quad 1$
Bit 5	$\frac{25}{2} = (2)12 + 1 \Rightarrow \quad 1$
Bit 6	$\frac{12}{2} = (2)6 + 0 \Rightarrow \quad 0$
Bit 7	$\frac{6}{2} = (2)3 + 0 \Rightarrow \quad 0$
Bit 8	$\frac{3}{2} = (2)1 + 1 \Rightarrow \quad 1$
Bit 9	$\frac{1}{2} = (2)0 + 1 \Rightarrow \quad 1$
Bit 10	$\frac{0}{2} = (2)0 + 0 \Rightarrow \quad 0$
Bit 11	$\frac{0}{2} = (2)0 + 0 \Rightarrow \quad 0$

823 in binary is $\boxed{001100110111_2}$

b) 209

$$
\begin{array}{c|l c}
\text{Bit 0} & \frac{209}{2} = (2)104 + 1 \Rightarrow & 1 \\[6pt]
\text{Bit 1} & \frac{104}{2} = (2)52 + 0 \Rightarrow & 0 \\[6pt]
\text{Bit 2} & \frac{52}{2} = (2)26 + 0 \Rightarrow & 0 \\[6pt]
\text{Bit 3} & \frac{26}{2} = (2)13 + 0 \Rightarrow & 0 \\[6pt]
\text{Bit 4} & \frac{13}{2} = (2)6 + 1 \Rightarrow & 1 \\[6pt]
\text{Bit 5} & \frac{6}{2} = (2)3 + 0 \Rightarrow & 0 \\[6pt]
\text{Bit 6} & \frac{3}{2} = (2)1 + 1 \Rightarrow & 1 \\[6pt]
\text{Bit 7} & \frac{1}{2} = (2)0 + 1 \Rightarrow & 1 \\[6pt]
\text{Bit 8} & \frac{0}{2} = (2)0 + 0 \Rightarrow & 0 \\[6pt]
\text{Bit 9} & \frac{0}{2} = (2)0 + 0 \Rightarrow & 0 \\[6pt]
\text{Bit 10} & \frac{0}{2} = (2)0 + 0 \Rightarrow & 0 \\[6pt]
\text{Bit 11} & \frac{0}{2} = (2)0 + 0 \Rightarrow & 0 \\
\end{array}
$$

209 in binary is $\boxed{000011010001_2}$

Problem 3:

a) 10110001010000010111_2

0101 1000 1010 0001 0111 $\Rightarrow$

$$
\begin{array}{c|c}
0111 & 7 \\
0001 & 1 \\
1010 & A \\
1000 & 8 \\
0101 & 5 \\
\end{array}
$$

$\boxed{58A17_{16}}$

b) 1938_{10}

$$
\begin{array}{c|lll}
\text{Bit 0} & \frac{1938}{16} = (16)124 + 2 \Rightarrow & & 2 \\[2mm]
\text{Bit 1} & \frac{124}{16} = (16)7 + 12 \Rightarrow & & 12 \Rightarrow C \\[2mm]
\text{Bit 2} & \frac{7}{16} = (16)0 + 7 \Rightarrow & & 7
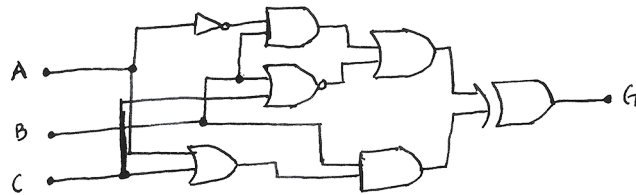\end{array}
$$

$$\boxed{7C2_{16}}$$

Problem 4:

a) 2FACED

$$
\begin{aligned}
2 &\Rightarrow 2 \times 16^5 \\
F &\Rightarrow 15 \times 16^4 \\
A &\Rightarrow 10 \times 16^3 \\
C &\Rightarrow 12 \times 16^2 \\
E &\Rightarrow 14 \times 16^1 \\
D &\Rightarrow 13 \times 16^0
\end{aligned}
$$

$$2 \times 16^5 + 15 \times 16^4 + 10 \times 16^3 + 12 \times 16^2 + 14 \times 16^1 + 13 \times 16^0 = \boxed{3124461}$$

Problem 5:

$$G = B(C + A) \oplus ((A'B) + (B + C)')$$

If ABC = 110, respectively, G would equal 1

Problem 6:

The two functions are not equal

A	B	C	D	B'CD	BC	AB'D	ABD'	Y
0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0
0	0	1	0	0	0	0	0	0
0	0	1	1	1	0	0	0	1
0	1	0	0	0	0	0	0	0
0	1	0	1	0	0	0	0	0
0	1	1	0	0	1	0	0	1
0	1	1	1	0	1	0	0	1
1	0	0	0	0	0	0	0	0
1	0	0	1	0	0	1	0	1
1	0	1	0	0	0	0	0	0
1	0	1	1	1	0	1	0	1
1	1	0	0	0	0	0	1	1
1	1	0	1	0	0	0	0	0
1	1	1	0	0	1	0	1	1
1	1	1	1	0	1	0	0	1

A	B	C	D	A+B+C'	B+D	A+C+D	B'+C'+D'	Z
0	0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1	1
0	0	1	0	0	0	1	1	0
0	0	1	1	0	1	1	1	0
0	1	0	0	1	0	1	1	0
0	1	0	1	1	1	1	1	1
0	1	1	0	1	1	1	1	1
0	1	1	1	1	1	1	0	0
1	0	0	0	1	0	1	1	0
1	0	0	1	1	1	1	1	1
1	0	1	0	1	0	1	1	0
1	0	1	1	1	1	1	1	1
1	1	0	0	1	1	1	1	1
1	1	0	1	1	1	1	1	1
1	1	1	0	1	1	1	1	1
1	1	1	1	1	1	1	0	0

Problem 7:

a can be either 0 or 1, but b has to be the opposite of a. For example, if a is 0 then b is 1 or vice versa.

Problem 8:

a) $101101 + 010101$

$$1^1 \quad 0^1 \quad 1^1 \quad 1 \quad 0^1 \quad 1 \qquad\qquad\qquad 4 \quad 5$$

+	0	1	0	1	0	1

overflow	0	0	0	0	1	0

+	2 1

overflow	2

b) $000101 + 010010$

	0	0	0	1	0	1
+	0	1	0	0	1	0

	0	1	0	1	1	1

		5
+	1	8

	2	3

Problem 9:

a) $+20$

$\boxed{010100}$

b) -30

$+30 \Rightarrow 011110$

$$0^1 \quad 1^1 \quad 1^1 \quad 1^1 \quad 1 \quad 0$$

+	1	0	0	0	1	0

~~1~~	0	0	0	0	0	0

$\boxed{100010}$

Problem 10:

a) 110000

$$0^1 \quad 1^1 \quad 0 \quad 0 \quad 1 \quad 0$$

+	1	1	0	0	0	0

~~1~~	0	0	0	0	0	0

$110000 \Rightarrow 010000$

$\boxed{-16}$

b) 011010

$\boxed{+26}$

Problem 11:

a) $7 + 18$

$+7 \Rightarrow 000111$

$+18 \Rightarrow 010010$

	0	0	0^1	1^1	1	1				7
+	0	1	0	0	1	0		+	1	8
	0	1	1	0	0	1			2	5

b) 12-29

$+12 \Rightarrow 001100$

$+29 \Rightarrow 011101$

	0^1	1^1	1^1	1^1	0^1	1
+	1	0	0	0	1	1
$\not{1}$	0	0	0	0	0	0

$-29 \Rightarrow 100011$

	0	0	1	1	0	0			1	2
+	1	0	0	0	1	1		-	2	9
	1	0	1	1	1	1		-	1	7

Problem 12:

A	B	C	D	F
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

Problem 13:

a) 2 great gross + 7 gross + 4 dozen + 10 cans

2 great gross $\Rightarrow 2 \times 12^3$

7 gross $\Rightarrow 7 \times 12^2$

4 dozen $\Rightarrow 4 \times 12^1$

9

$$10 \text{ cans} \Rightarrow 10 \times 12^0$$

$$2 \times 12^3 + 7 \times 12^2 + 4 \times 12^1 + 10 \times 12^0 = \boxed{4522}$$

b) 6903_{10}

Bit 0	$\frac{6903}{12} = (12)575 + 3 \Rightarrow \quad 3$
Bit 1	$\frac{575}{12} = (12)47 + 11 \Rightarrow \quad 11$
Bit 2	$\frac{47}{12} = (12)3 + 11 \Rightarrow \quad 11$
Bit 3	$\frac{3}{12} = (12)0 + 3 \Rightarrow \quad 3$

$\boxed{3 \text{ great gross} + 11 \text{ gross} + 11 \text{ dozen} + 10 \text{ cans}}$

Problem 14:

Bit 0	$\frac{2021}{2} = (2)1010 + 1 \Rightarrow \quad 1$
Bit 1	$\frac{1010}{2} = (2)505 + 0 \Rightarrow \quad 0$
Bit 2	$\frac{505}{2} = (2)252 + 1 \Rightarrow \quad 1$
Bit 3	$\frac{252}{2} = (2)126 + 0 \Rightarrow \quad 0$
Bit 4	$\frac{126}{2} = (2)63 + 1 \Rightarrow \quad 1$
Bit 5	$\frac{63}{2} = (2)31 + 1 \Rightarrow \quad 1$
Bit 6	$\frac{31}{2} = (2)15 + 1 \Rightarrow \quad 1$
Bit 7	$\frac{15}{2} = (2)7 + 1 \Rightarrow \quad 1$
Bit 8	$\frac{7}{2} = (2)3 + 1 \Rightarrow \quad 1$
Bit 9	$\frac{3}{2} = (2)1 + 1 \Rightarrow \quad 1$
Bit 10	$\frac{1}{2} = (2)0 + 1 \Rightarrow \quad 1$
Bit 11	$\frac{0}{2} = (2)0 + 0 \Rightarrow \quad 0$

2021 in unsigned binary is $\boxed{011111100101_2}$

$011111100101 \Rightarrow 0111\ 1110\ 0101$

0111	7
1110	E
0101	5

$\boxed{7E5_{16}}$

Problem 15: Problem 16: