

# 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 800+ 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.

Here are the answers to the problems. The subsequent work are located further in the document.

**Problem 1:**

a)

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

b) 0001011110

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

c) 101010110010

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

**Problem 2:**

a) 823

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

b) 209

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

**Problem 3:**

a) 1011000101000010111<sub>2</sub>

$$\boxed{58A17_{16}}$$

b) 1938<sub>10</sub>

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

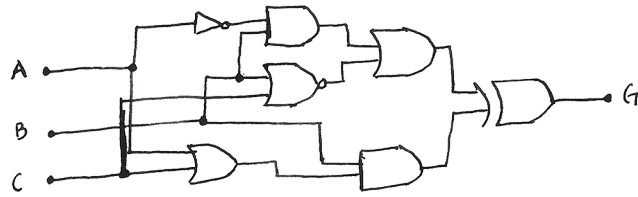
**Problem 4:**

a) 2FACED

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

**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

**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 <sup>1</sup>	0 <sup>1</sup>	1 <sup>1</sup>	1	0 <sup>1</sup>	1			4	5
	+	0	1	0	1	0	1		+	2	1
		<hr/>								<hr/>	
overflow		0	0	0	0	1	0		overflow		2

b)  $000101 + 010010$

		0	0	0	1	0	1			5	
	+	0	1	0	0	1	0		+	1	8
		<hr/>								<hr/>	
		0	1	0	1	1	1			2	3

**Problem 9:**

a) +20

010100

b) -30

100010

**Problem 10:**

a) 110000

-16

b) 011010

+26

**Problem 11:**

a)  $7 + 18$

			0	0	0 <sup>1</sup>	1 <sup>1</sup>	1	1				7
	+	0	1	0	0	0	1	0		+	1	8
			0	1	1	0	0	1			2	5

b)  $12-29$

			0	0	1	1	0	0			1	2
	+	1	0	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

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

b)  $6903_{10}$

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

**Problem 14:**

2021 in hex is  $\boxed{7E5_{16}}$

**Problem 15:**

**Problem 16:**

a)  $-23 - 13$

			1	0	1	0	0	1		-	2	3
	+		1	1	0	0	1	1		-	1	3
			<hr/>								<hr/>	
overflow		0	1	1	1	0	0			overflow	2	6

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

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

b) 209



Bit 0	$\frac{209}{2} = (2)104 + 1 \Rightarrow$	1
Bit 1	$\frac{104}{2} = (2)52 + 0 \Rightarrow$	0
Bit 2	$\frac{52}{2} = (2)26 + 0 \Rightarrow$	0
Bit 3	$\frac{26}{2} = (2)13 + 0 \Rightarrow$	0
Bit 4	$\frac{13}{2} = (2)6 + 1 \Rightarrow$	1
Bit 5	$\frac{6}{2} = (2)3 + 0 \Rightarrow$	0
Bit 6	$\frac{3}{2} = (2)1 + 1 \Rightarrow$	1
Bit 7	$\frac{1}{2} = (2)0 + 1 \Rightarrow$	1
Bit 8	$\frac{0}{2} = (2)0 + 0 \Rightarrow$	0
Bit 9	$\frac{0}{2} = (2)0 + 0 \Rightarrow$	0
Bit 10	$\frac{0}{2} = (2)0 + 0 \Rightarrow$	0
Bit 11	$\frac{0}{2} = (2)0 + 0 \Rightarrow$	0

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

**Problem 3:**

a)  $1011000101000010111_2$

$0101\ 1000\ 1010\ 0001\ 0111 \Rightarrow$

0111	7
0001	1
1010	A
1000	8
0101	5

$\boxed{58A17_{16}}$

b)  $1938_{10}$

Bit 0	$\frac{1938}{16} = (16)124 + 2 \Rightarrow$	2
Bit 1	$\frac{124}{16} = (16)7 + 12 \Rightarrow$	$12 \Rightarrow C$
Bit 2	$\frac{7}{16} = (16)0 + 7 \Rightarrow$	7

$7C2_{16}$

**Problem 4:**

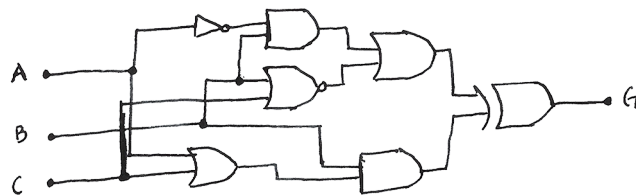
a) 2FACED

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

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

**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)  $101101 + 010101$

$$\begin{array}{rcccccc}
 & 1^1 & 0^1 & 1^1 & 1 & 0^1 & 1 \\
 + & 0 & 1 & 0 & 1 & 0 & 1 \\
 \hline
 \text{overflow} & 0 & 0 & 0 & 0 & 1 & 0
 \end{array}
 \qquad
 \begin{array}{rcc}
 & 4 & 5 \\
 + & 2 & 1 \\
 \hline
 \text{overflow} & & 2
 \end{array}$$

b)  $000101 + 010010$

$$\begin{array}{rcccccc}
 & 0 & 0 & 0 & 1 & 0 & 1 \\
 + & 0 & 1 & 0 & 0 & 1 & 0 \\
 \hline
 & 0 & 1 & 0 & 1 & 1 & 1
 \end{array}
 \qquad
 \begin{array}{rcc}
 & 5 \\
 + & 1 & 8 \\
 \hline
 & 2 & 3
 \end{array}$$

**Problem 9:**

a)  $+20$

010100

b)  $-30$

$+30 \Rightarrow 011110$

$$\begin{array}{rcccccc}
 & 0^1 & 1^1 & 1^1 & 1^1 & 1 & 0 \\
 + & 1 & 0 & 0 & 0 & 1 & 0 \\
 \hline
 \cancel{x} & 0 & 0 & 0 & 0 & 0 & 0
 \end{array}$$

100010

**Problem 10:**

a)  $110000$

$$\begin{array}{rcccccc}
 & 0^1 & 1^1 & 0 & 0 & 1 & 0 \\
 + & 1 & 1 & 0 & 0 & 0 & 0 \\
 \hline
 \cancel{x} & 0 & 0 & 0 & 0 & 0 & 0
 \end{array}$$

$$110000 \Rightarrow 010000$$

$$\boxed{-16}$$

b) 011010

$$\boxed{+26}$$

**Problem 11:**

a)  $7 + 18$

$$+7 \Rightarrow 000111$$

$$+18 \Rightarrow 010010$$

$$\begin{array}{rcccccc} & 0 & 0 & 0^1 & 1^1 & 1 & 1 & & 7 \\ + & 0 & 1 & 0 & 0 & 1 & 0 & + & 1 & 8 \\ \hline & 0 & 1 & 1 & 0 & 0 & 1 & & 2 & 5 \end{array}$$

b) 12-29

$$+12 \Rightarrow 001100$$

$$+29 \Rightarrow 011101$$

$$\begin{array}{rcccccc} & 0^1 & 1^1 & 1^1 & 1^1 & 0^1 & 1 \\ + & 1 & 0 & 0 & 0 & 1 & 1 \\ \hline \cancel{1} & 0 & 0 & 0 & 0 & 0 & 0 \end{array}$$

$$-29 \Rightarrow 100011$$

$$\begin{array}{rcccccc} & 0 & 0 & 1 & 1 & 0 & 0 & & 1 & 2 \\ + & 1 & 0 & 0 & 0 & 1 & 1 & - & 2 & 9 \\ \hline & 1 & 0 & 1 & 1 & 1 & 1 & - & 1 & 7 \end{array}$$

**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

$$2 \text{ great gross} \Rightarrow 2 \times 12^3$$

$$7 \text{ gross} \Rightarrow 7 \times 12^2$$

$$4 \text{ dozen} \Rightarrow 4 \times 12^1$$

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

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

b)  $6903_{10}$

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

3 great gross + 11 gross + 11 dozen + 10 cans
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**Problem 14:**

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

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



$$011111100101 \Rightarrow 0111\ 1110\ 0101$$

0111		7
1110		E
0101		5

$$2021 \text{ in hex is } \boxed{7E5_{16}}$$

**Problem 15:**

**Problem 16:**

a)  $-23 - 13$

$$+23 \Rightarrow 010111$$

	0 <sup>1</sup>	1 <sup>1</sup>	0 <sup>1</sup>	1 <sup>1</sup>	1 <sup>1</sup>	1
+	1	0	1	0	0	1
<hr/>						
⌵	0	0	0	0	0	0

$$-23 \Rightarrow 101001$$

$$+13 \Rightarrow 001101$$

	0 <sup>1</sup>	0 <sup>1</sup>	1 <sup>1</sup>	1 <sup>1</sup>	0 <sup>1</sup>	1
+	1	1	0	0	1	1
<hr/>						
⌵	0	0	0	0	0	0

$$-13 \Rightarrow 110011$$

	1	0	1	0	0	1		-	2	3
+	1	1	0	0	1	1		-	1	3
<hr/>								<hr/>		
overflow	0	1	1	1	0	0		overflow	2	6