HW1

1. (8%) What is the exact number of bits in a system that contains (a) 16M byte and (b) 8.3G byte?

(a) 16M Byte =	16 * 2^20 * 2^3	=>	134,217,728
(b) 8.3G Byte =	8.3 * 2^30 * 2^3(71,296,457,113.6)	=>	71,296,457,114

2. (24%) Convert the following numbers from the given base to other three bases listed in the table:

Decimal	Binary	Octal	Hexadecimal
384.57	**110000000.1001**	**600.4436**	**180.91EB**
26.625	**11010.101**	**32.5**	**1A.A**
30.53125	**11110.10001**	**36.42**	**1E.88**
249.25	**11111001.01**	**371.2**	**F9.4**

$(384.57)_{10} \to$ binary

384.57

$384/2=192 \cdots 0$, $192/2=96 \cdots 0$, $96/2=48 \cdots 0$, $48/2=24 \cdots 0$, $24/2=12 \cdots 0$, $12/2=6 \cdots 0$, $6/2=3 \cdots 0$, $3/2=1 \cdots 1$, $1/2=0 \cdots 1$

$0.57\times2=1.14$, $0.14\times2=0.28$, $0.28\times2=0.56$, $0.56\times2=1.12$, $0.12\times2=0.24$, $0.24\times2=0.48$, $0.48\times2=0.96$, $0.96\times2=1.92$, $0.92\times2=1.84$, $0.84\times2=1.68$, $0.68\times2=1.36$, $0.36\times2=0.72$, $0.72\times2=1.44$, $0.44\times2=0.88$, $0.88\times2=1.76$, $0.76\times2=1.52$

110000000.1001

$(384.57)_{10} \xrightarrow{\text{binary}}$ octal

110000000.100100011110

6 0 0 . 4 4 3 6

$(384.57)_{10} \xrightarrow{\text{binary}}$ hexadecimal

000110000000.100100011110 1011

1 8 0 . 9 1 E B

$(11010.101)_2 \to$ decimal

11010.101

$\Rightarrow 1\times2^4+1\times2^3+0\times2^2+1\times2^1+0\times2^0+1\times2^{-1}+0\times2^{-2}+1\times2^{-3} = 26.625$

$(11010.101)_2 \to$ octal

011 010 . 101

3 2 . 5

$(11010.101)_2 \to$ hexadecimal

00011010.1010

1 A . A

$(36.42)_8 \to$ binary

3 6 . 4 2

011110.100010

$(36.42)_8 \to$ decimal

$\Rightarrow 3\times8^1+6\times8^0+4\times8^{-1}+2\times8^{-2} = 30.53125$

$(36.42)_8 \xrightarrow{\text{binary}}$ hexadecimal

011110.100010

1 E . 8 8

$(F9.4)_{16} \to$ binary

F 9 . 4

11111001.0100

$(F9.4)_{16} \to$ decimal

$\Rightarrow 15\times16^1+9\times16^0+4\times16^{-1} = 249.25$

$(F9.4)_{16} \xrightarrow{\text{binary}}$ octal

011111001.0100

3 7 1 . 2

3. (16%) Perform the subtraction with the following unsigned binary numbers by taking the 2's complement of the subtrahend. (a) 0111 – 0110, (b) 10010 – 1010, (c) 1010110 – 1111010, (d) 101101 – 110.

(a)

$$\begin{array}{r} 00\ 0111 \\ +\ 11\ 1010 \\ \hline 00\ 0001 \end{array}$$

(b)

$$\begin{array}{r} 001\ 0010 \\ +\ 111\ 0110 \\ \hline 000\ 1000 \end{array}$$

(c)

$$\begin{array}{r} 00101\ 0110 \\ +\ 11000\ 0110 \\ \hline 11101\ 1100 \end{array}$$

(d)

$$\begin{array}{r} 0010\ 1101 \\ +\ 1111\ 1010 \\ \hline 0010\ 0111 \end{array}$$

4. (16%) Convert decimal +47 and +38 to binary, using the signed-2's-complement representation and enough digits to accommodate the numbers, Then, perform the binary equivalent of (+47)+(-38) and (-47)+(-38) using addition. Convert the answers back to decimal and verify that they are correct.

$47_{(10)} = 0010\_1111_{(2)}$ $\quad -47_{(10)} = 1101\_0001_{(2)}$

$38_{(10)} = 0010\_0110_{(2)}$ $\quad -38_{(10)} = 1101\_1010_{(2)}$

$$\begin{array}{rl} 0010\ 1111 & 47_{(10)} \\ +\ 1101\ 1010 & -38_{(10)} \\ \hline \boxed{1}0000\ 1001 & 9_{(10)} \end{array}$$

carry out w/o overflow sum is correct

$$\begin{array}{rl} 1101\ 0001 & -47_{(10)} \\ +\ 1101\ 1010 & -38_{(10)} \\ \hline \boxed{1}\ 1010\ 1011 & -85_{(10)} \end{array}$$

carryout w/o overflow sum is correct

5. (10%) Write the word "Logic" in ASCII using an eight-bit code including the space. Treat the leftmost bit of each character as a parity bit. Each 8-bit code should have even parity.

↓---- parity bit

L： 1100 1100

o： 0110 1111

g： 1110 0111

i： 0110 1001

c： 0110 0011

6. (8%) For an 8-bit sequence is 1101 0111. What is its content if it represents (a) two decimal digits in BCD? (b) two decimal number in the Excess-3 code? (c) an 8-bit unsigned number? (d) an 8-bit signed number?

a. $1101_{(2)}$ = unused$_{(10)}$ $0111_{(2)} = 7_{(10)}$

b. $1101_{(2)}$ = unused $_{(10)}$ $0111_{(2)} = 4_{(10)}$

c. $1101\ 0111_{(2)} = 215_{(10)}$

d. $1101\ 0111_{(2)} = -41_{(10)}$

7. (6%) If you have 27 books and want to give each book a unique id with a binary number. If we want to use as least as possible the number of bits as the id, how many bits do you need?

27 unique IDs which means the number of bits you need could at least represent 27 unique numbers .

$2^5 > 27 > 2^4$

Ans : 5 bits

8. (12%) Find the Gray code sequence of 12 code words.

$M = 2k = 12$, $k = 6$

$g_3 = 0$ (MSB = 0)
$g_2 = d_3 \oplus d_2 = 0 \oplus 0 = 0$
$g_1 = d_2 \oplus d_1 = 0 \oplus 0 = 0$
$g_0 = d_1 \oplus d_0 = 0 \oplus 0 = 0$

D	$d_3d_2d_1d_0$		$g_3g_2g_1g_0$
0	0000	→	0000
1	0001	→	0001
2	0010	→	0011
3	0011	→	0010
4	0100	→	0110
5	0101	→	0111
6	0110	→	1111
7	0111	→	1110
8	1000	→	1010
9	1001	→	1011
10	1010	→	1001
11	1011	→	1000

For the rest half codes set MSB = 1 then copy in reverse order of first half part!