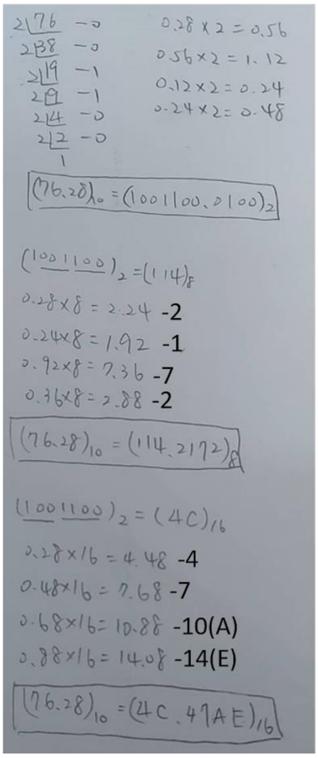
HW1

1. (36%) Convert the following numbers from the given base to other three bases listed in the table (to the 4th digit after radix point):

Decimal	Binary	Octal	Hexadecimal
76.28	1001100.0100	114.2172	4C.47AE
9.625	1001.1010	11.5	9.A
48.37不屬於8進位，故無解		48.37	
127.140625	1111111.0010	177.11	7F.24

1.



2|76 -0
2|38 -0
2|19 -1
2|9 -1
2|4 -0
2|2 -0
1

$0.28\times2=0.56$
$0.56\times2=1.12$
$0.12\times2=0.24$
$0.24\times2=0.48$

$\boxed{(76.28)_{10}=(1001100.0100)_2}$

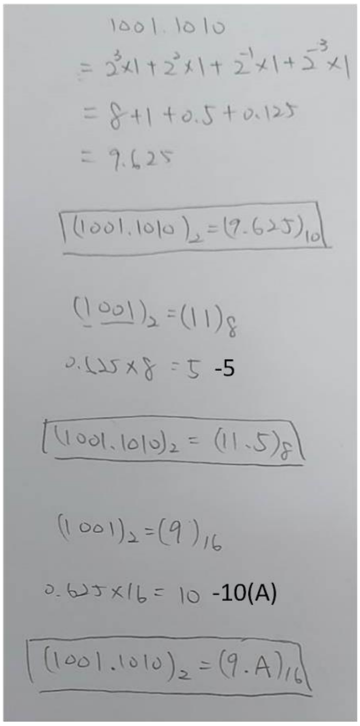
$(1001100)_2=(114)_8$
$0.28\times8=2.24$ -2
$0.24\times8=1.92$ -1
$0.92\times8=7.36$ -7
$0.36\times8=2.88$ -2

$\boxed{(76.28)_{10}=(114.2172)_8}$

$(1001100)_2=(4C)_{16}$
$0.28\times16=4.48$ -4
$0.48\times16=7.68$ -7
$0.68\times16=10.88$ -10(A)
$0.88\times16=14.08$ -14(E)

$\boxed{(76.28)_{10}=(4C.47AE)_{16}}$

2.



1001.1010
$=2^3\times1+2^0\times1+2^{-1}\times1+2^{-3}\times1$
$=8+1+0.5+0.125$
$=9.625$

$\boxed{(1001.1010)_2=(9.625)_{10}}$

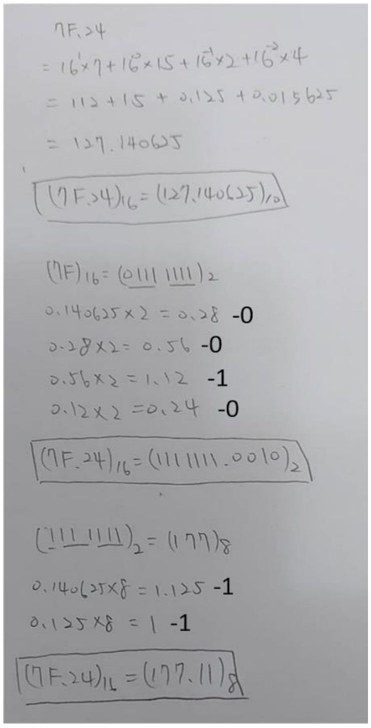
$(1001)_2=(11)_8$
$0.625\times8=5$ -5

$\boxed{(1001.1010)_2=(11.5)_8}$

$(1001)_2=(9)_{16}$
$0.625\times16=10$ -10(A)

$\boxed{(1001.1010)_2=(9.A)_{16}}$

4.



7F.24
$=16^1\times7+16^0\times15+16^{-1}\times2+16^{-2}\times4$
$=112+15+0.125+0.015625$
$=127.140625$

$\boxed{(7F.24)_{16}=(127.140625)_{10}}$

$(7F)_{16}=(0111\ 1111)_2$
$0.140625\times2=0.28$ -0
$0.28\times2=0.56$ -0
$0.56\times2=1.12$ -1
$0.12\times2=0.24$ -0

$\boxed{(7F.24)_{16}=(1111111.0010)_2}$

$(1111111)_2=(177)_8$
$0.140625\times8=1.125$ -1
$0.125\times8=1$ -1

$\boxed{(7F.24)_{16}=(177.11)_8}$

 Fall, 2020

2. (16%) Perform the subtraction with the following unsigned binary numbers by taking the 2's complement of the subtrahend. (a) 0101 – 0111, (b) 10101 – 0110, (c) 1011101 – 1111001, (d) 101011 – 1101.

紅色為補位

2. (a)
```
   00  0101
+  11  1001
-----------
   11  1110
```

(b)
```
   00  10101
+  11  11010
------------
   00  01111
```

(c)
```
   00  1011101
+  11  0000111
--------------
   11  1100100
```

(d)
```
   00  101011
   11  110011
-------------
   00  011110
```

3. (16%) Convert decimal +29 and +75 to binary, using the signed-2's-complement representation and enough digits to accommodate the numbers, Then, perform the binary equivalent of (+29)+(-75) and (-29)+(-75) using addition. Convert the answers back to decimal and verify that they are correct.

$29 = 16 + 8 + 4 + 1 = 2^4 + 2^3 + 2^2 + 2^0 \Rightarrow 00011101_{(2)}$

$75 = 64 + 8 + 2 + 1 = 2^6 + 2^3 + 2^1 + 2^0 \Rightarrow 01001011_{(2)}$

$-29 = 11100010 + 1 = 11100011_{(2)}$

$-75 = 10110100 + 1 = 10110101_{(2)}$

(+29)+(-75)
```
    00011101
+)  10110101
------------
    11010010(2)
```
↳ $-128+64+16+2 = -46_{(10)}$

⇒ sum is correct

(-29)+(-75)
```
    11100011
+)  10110101
------------
   110011000
```
↳ $-256+128+16+8 = -104_{(10)}$

⇒ sum is correct

4. (8%) Write the word "NTHU" 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.

字元	十進位	十六進位	二進位	Ans: Even parity
N	78	4E	0100 1110	0100 1110
T	84	54	0101 0100	1101 0100
H	72	48	0100 1000	0100 1000
U	85	55	0101 0101	0101 0101

判斷是否為偶數個1，否則改最左位1

5. (8%) For an 8-bit sequence is 1001 0101. 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?

5.

(a) $(1001\ 0101)_{BCD} = (2^3 + 2^0) \times 10^1 + (2^2 + 2^0) \times 10^0 = (95)_{10}$

(b)查表知 $(1001\ 0101)_{Excess\text{-}3} = (62)_{10}$

Decimal Digit	BCD 8421	2421	Excess-3	8, 4, −2, −1
0	0000	0000	0011	0000
1	0001	0001	0100	0111
2	0010	0010	0101	0110
3	0011	0011	0110	0101
4	0100	0100	0111	0100
5	0101	1011	1000	1011
6	0110	1100	1001	1010
7	0111	1101	1010	1001
8	1000	1110	1011	1000
9	1001	1111	1100	1111
	1010	0101	0000	0001
Unused bit combi-nations	1011	0110	0001	0010
	1100	0111	0010	0011
	1101	1000	1101	1100
	1110	1001	1110	1101
	1111	1010	1111	1110

(c) $(1001\ 0101)_{unsigned\ number} = (2^7 + 2^4 + 2^2 + 2^0)_{10} = (149)_{10}$

(d) $(1001\ 0101)_{signed\ number} = (-2^7 + 2^4 + 2^2 + 2^0)_{10} = -(107)_{10}$

6. (4%) If you have 20 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?

   (sol)

   $2^5 > 20 > 2^4$

   Ans : 5 bit

7. (12%) Find the Gray code sequence of 14 code words.

$M = 2k = 14$, $k = 7$

D	$d_3d_2d_1d_0$	$g_3g_2g_1g_0$ (MSB ↑ g_3)
0	0 0 0 0	0 0 0 0
1	0 0 0 1	0 0 0 1
2	0 0 1 0	0 0 1 1
3	0 0 1 1	0 0 1 0
4	0 1 0 0	0 1 1 0
5	0 1 0 1	0 1 1 1
6	0 1 1 0	0 1 0 1
7	0 1 1 1	1 1 0 1
8	1 0 0 0	1 1 1 1
9	1 0 0 1	1 1 1 0
10	1 0 1 0	1 0 1 0
11	1 0 1 1	1 0 1 1
12	1 1 0 0	1 0 0 1
13	1 1 0 1	1 0 0 0

First half $\frac{M}{2}$ codes (D = 0 to 6):

1° let MSB (g_3) = 0 , 2° $\begin{cases} g_2 = d_3 \oplus d_2 \\ g_1 = d_2 \oplus d_1 \\ g_0 = d_1 \oplus d_0 \end{cases}$

rest half $\frac{M}{2}$ code (D = 7 to 13):

3° copy & reverse the first half $g_2g_1g_0$

4° let MSB $g_3 = 1$