CS4341 Assignment 5

(1A) -13.5625

{ 8 integer bits ①
8 fraction bits ②

For the integer bits

$$\begin{array}{r|l} 2 \,|\, 13 & 1 \\ 2 \,|\, 6 & 0 \\ 2 \,|\, 3 & 1 \\ 2 \,|\, 1 & 1 \\ 1 & \end{array} \xrightarrow{\text{invert}} 1101$$

① So the first 8 bits in interger part is 00001101

② for the fraction bits

$0.5625 \times 2 = 1.125$ 1

$0.125 \times 2 = 0.25$ 0

$0.25 \times 2 = 0.5$ 0

$0.5 \times 2 = 1$ 1

so the second part for fraction is 10010000.

so 16 bit fixed point is 00001101 . 10010000

because -13.5625 is negative, so change first sign bits to 1

Sign/magnitude : $\boxed{10001101 . 10010000}$

To change to hexadecimal, seperate to differen 4-bits chunks

1000|1101 . 1001|0000

↓ ↓ ↓ ↓

hexa : 8 D 9 0

So in hexadecimal, the answer is $\boxed{0x\ 8D90}$.

(1B) 42.3125

① For the integer part

2 | 42
2 | 21 ... 0
2 | 10 ... 1
2 | 5 ... 0
2 | 2 ... 1
2 | 1 ... 0
0 ... 1

$$42 = 2^5 + 2^3 + 2^1$$
$$= 32 + 8 + 2$$
$$= 42$$

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
0	0	1	0	1	0	1	0

so 00101010 is the integer part

② For fraction part

$0.3125 \times 2 = 0.625$ 0
$0.625 \times 2 = 1.25$ 1
$0.25 \times 2 = 0.5$ 0
$0.5 \times 2 = 1$ 1

So fraction part is 01010000.

16 bit fixed $\Rightarrow$ $\boxed{00101010.01010000}$ positive, no needs change sign.

To change to hexadecimal

0010	1010	0101	0000
↓	↓	↓	↓
2	A	5	0

hexa 2 A 5 0

So the hexadecimal is $\boxed{0x\ 2A50}$

(1C) -17.15625

① For the integer part.

$17 = 2^4 + 2^0 = 16+1 = 17$

so ~~000~~0 $00\overset{2^4}{1}000\overset{2^0}{1}$ is the integer part

② For fraction part.

$0.15625 \times 2 = 0.3125$	0
$0.3125 \times 2 = 0.625$	0
$0.625 \times 2 = 1.25$	1
$0.25 \times 2 = 0.5$	0
$0.5 \times 2 = 1$	1

so fraction part is 00101000

16-bit-fixed $\Rightarrow$ $\boxed{\underset{8}{1}0010001.00101000}$ (change sign because negative)

for hexadecimal

	1001	0001	0010	1000
	↓	↓	↓	↓
hexa	9	1	2	8

so the hexadecimal is $\boxed{0x\ 9128}$

-13.5625

(1D) From the previous answer, -13.5625 in sign magnitude is 10001101.10010000

So invert all the bits and plus 1, we have

fixed 16 bits	00001101.10010000
one's complement	11110010.01101111
two's complement	+1
	11110010.01110000

So the two's complement is $\boxed{11110010.01110000}$

hexa F 2 7 0

The hexa decimal is $\boxed{0xF270}$

(1E) 42.3125

fixed 16 bits fixed 00101010.01010000

It is positive number, so it's two's complement will be the same

for $\boxed{00101010.01010000}$

and hexadecimal is same as 0x2A50.

(1F) -17.15625

16 bit fixed,	0001 0001 . 0010 1000	
1's complement.	1110 1110 . 1101 0111	
2's complement.	+ 1	
	1110 1110 . 1101 1000	

so it's two's complement is $\boxed{11101110.11011000}$

hexa

E E D 8.

it's hexadecimal is 0x EED8

2. $X = AB + B\bar{C}D + \bar{A}\bar{B}$

$Y = AB + BD$

$Z = A + B + C + D$

rewrite x with null elements

$X = AB(C+\bar{C})(D+\bar{D}) + (A+\bar{A})B\bar{C}D + \bar{A}\bar{B}(C+\bar{C})(D+\bar{D})$

$= \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD + \bar{A}B\bar{C}D + AB\bar{C}\bar{D} + AB\bar{C}D$

$+ ABC\bar{D} + ABCD$

so $X = \sum_m (0,1,2,3,5,12,13,14,15)$

same for Y

$Y = AB + BD = AB(C+\bar{C})(D+\bar{D}) + \cancel{BD}(A+\bar{A})B(C+\bar{C})D$

$= \bar{A}B\bar{C}D + \bar{A}BCD + AB\bar{C}D + AB\bar{C}\bar{D} + ABC\bar{D} + ABCD$

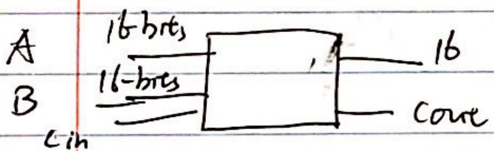
$= \sum m(5,7,12,13,14,15)$

$$Z = A+B+C+D$$
$$= A(B+\bar{B})(C+\bar{C})(D+\bar{D}) + B(A+\bar{A})(C+\bar{C})(D+\bar{D}) +$$
$$C(A+\bar{A})(B+\bar{B})(D+\bar{D}) + D(A+\bar{A})(B+\bar{B})(C+\bar{C})$$

$$= \sum m(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15)$$

Graph of 16x3 ROM shows on Another page.

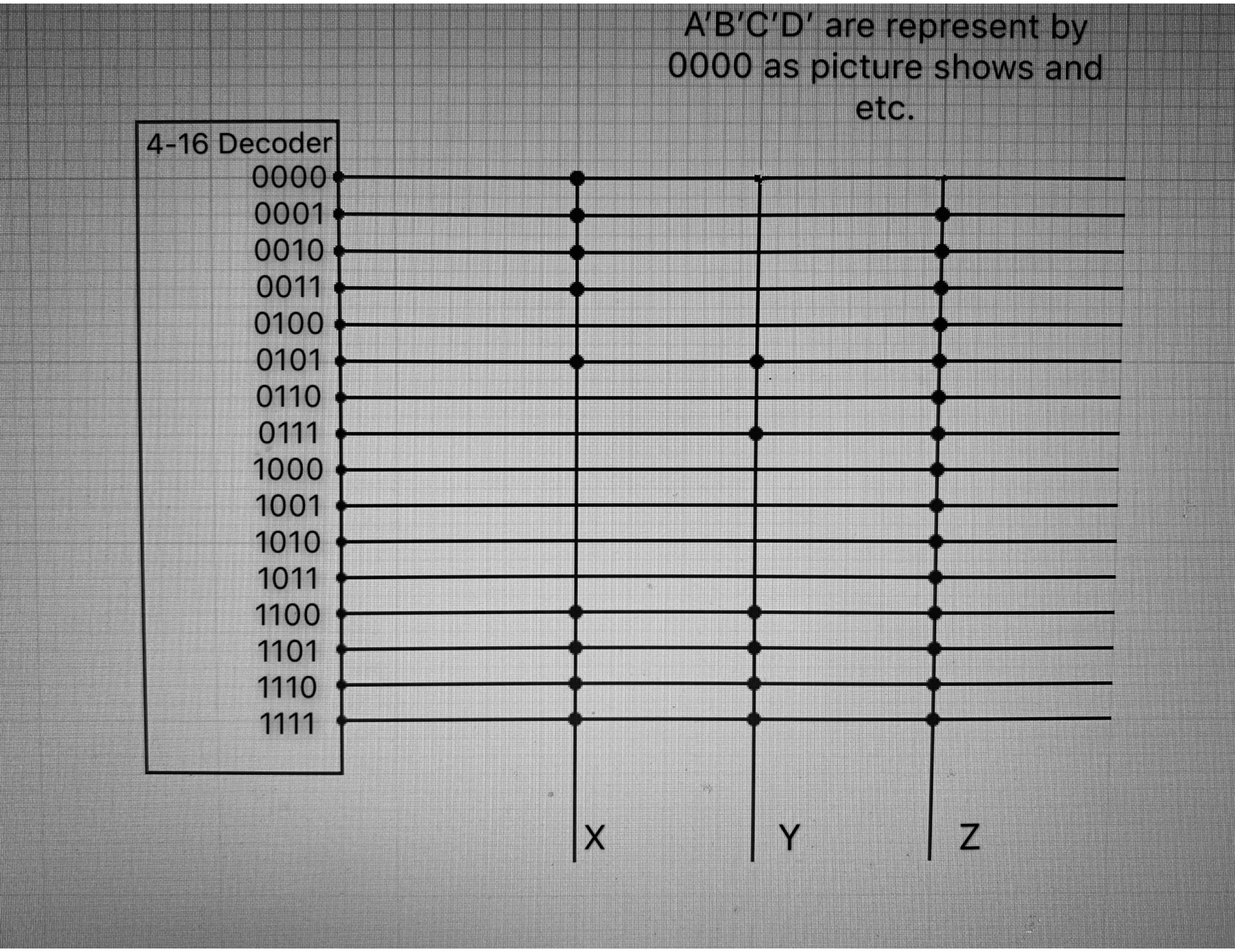
(3A) 16 bit adder and substractor with Cin and Cout



there are total 33 inputs and 17 outputs

It's not good to ~~store~~ design, because it can be designed using modules of full adder, the structures are basic gates

(3B) 8x8 Mutiplier, there are total 16 inputs and 16 outputs
By multiplying 2-8bits, we required 16-bits $2^8 \cdot 2^8 = 2^{16}$,
So total $2^{16} \times 16$ ROM is good.


A'B'C'D' are represent by
0000 as picture shows and
etc.
4-16 Decoder
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111
X
Y
Z