CSE 220.90 Assignment 1 Wooyoung Jung 114744214

1. (a) 45_{10} — 0 0 1 0 1 1 0 1
128 64 32 16 8 4 2 1

2 | 45
2 | 22 r1
2 | 11 r0
2 | 5 r1
2 | 2 r1
2 | 1 r0
1 r1

$\therefore 45_{10} = 0010\ 1101_2$.

(b) 108_{10}

2 | 108
2 | 54 r0
2 | 27 r0
2 | 13 r1 $\Rightarrow$ 0110 1100
2 | 6 r1
2 | 3 r0
1 r1
1 r1
0

$\therefore 108_{10} = 0110\ 1100_2$.

2. (a) $0010\ 1101_2$
$= 2\ 13_{10}$
$= 2\ D_{16}$.

(b) $0110\ 1100_2$
$= 6\ 12_{10}$
$= 6\ C_{16}$

Dec	Hex
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	A
11	B
12	C
13	D
14	E
15	F

3. (a) $0011\ 0110_2$
32 16 8 4 2 1
$= 32+16+4+2$
$= 54_{10}$.

(b) $0101\ 0101_2$
64 32 16 8 4 2 1
$= 64+16+4+1$
$= 85_{10}$.

4. (a) $\underset{16^3}{A}\ \underset{16^2}{1}\ \underset{16^1}{2}\ \underset{16^0}{B}{}_{(16)}$
$= 10*16^3 + 1*16^2 + 2*16^1 + 11*16^0$
$= 40960 + 256 + 32 + 11$
$= 41259_{(10)}$.

(b) $\underset{16^3}{1}\ \underset{16^2}{C}\ \underset{16^1}{0}\ \underset{16^0}{D}$
$= 1*16^3 + 12*16^2 + 0*16^1 + 13*16^0$
$= 4096 + 3072 + 0 + 13$
$= 7181_{(10)}$.

5. (a) $-11_{(10)}$.
$11_{(10)} \Rightarrow 0000\ 1011$. Convert to true binary.
$= 1111\ 0100$ Invert the bits.
$= 1111\ 0101_{(2)}$ Add 1.

(b) $-37_{(10)}$.
$37_{(10)} \Rightarrow 0010\ 0101_{(2)}$. Convert to true binary.
$= 1101\ 1010_{(2)}$. Invert the bits.
$= 1101\ 1011_{(2)}$ Add 1.

6. (a) $1011\ 1101_{(2C)} \Rightarrow 1110\ 1101_{(2C)}$

Perform sign extension to 8-bit.

$1110\ 1101_{(2C)}$.

$= 0001\ 0010$. Flip the bits.

$= 0001\ 0011$. Add 1.

$= 2^3 + 0 + 0 + 2^1 + 2^0 = 16 + 2 + 1 = 19_{10}$.

$\Rightarrow -19_{10}$. Prepend negative sign.

Verify: -19_{10} to 2C.

$19_{10} \Rightarrow 0001\ 0011$

$= 1110\ 1100$. Flip the sign.

$= 1110\ 1101$. Add 1. ✓

(b) $110\ 1101_{(2C)} \Rightarrow 1110\ 1101_{(2C)}$.

Extend sign.

$1110\ 1101_{(2C)}$

$= 0001\ 0010$. Flip the bits.

$= 0001\ 0011$. Add 1.

$= 1*2^4 + 0*2^3 + 0*2^2 + 1*2^1 + 1*2^0$

$= 16 + 0 + 0 + 2 + 1 = 19$.

$\Rightarrow -19_{10}$. Prepend negative sign.

✡ Leading 1's of a 2's complement binary number are redundant; multiple MSBs are often used to represent the sign after sign extension.

7. (a) 11.625_{10}

$2^1\ 2^0\ 2^{-1}\ 2^{-2}\ 2^{-3}\ 2^{-4}$

$= 1011.1010$

(Simplified)

$= 1.0111010 \times 2^3$.

Fraction

$2 \mid 11$

$2 \mid 5$ r1

$2 \mid 2$ r1

$2 \mid 1$ r0

1 r1

read up.

$0.625 * 2 = 1.25$

$0.25 * 2 = 0.5$

$0.5 * 2 = 1.0$

$0.0 * 2 = 0.0$

read down.

$E' = 127 + 3 = 130 = 1000\ 0010_2$

Sign = 0

Fraction = 011 1010 0000 0000 0000 0000

130_{10} to binary:

$2 \mid 130$

$2 \mid 65$ r0

$2 \mid 32$ r1

$2 \mid 16$ r0

$2 \mid 8$ r0

$2 \mid 4$ r0

$2 \mid 2$ r0

$2 \mid 1$ r0

1 r1

$= 1000\ 0010_2$.

0 | 1000 0010 | 011 1010 0000 0000 0000 0000

Sign | Exponent' | Fraction. (IEEE-754).

Divide into nibbles to convert to hex:

0100 0001 0011 1010 0000 0000 0000 0000

$= 4\ 1\ 3\ A\ 0\ 0\ 0\ 0$

$= 0X413A0000_{(16)}$.

7.(b) -0.15625_{10}

$0.15625 * 2 = 0.3125$
$0.3125 * 2 = 0.625$
$0.625 * 2 = 1.25$
$0.25 * 2 = 0.5$
$0.5 * 2 = 1.0$
$0 * 2 = 0.0$

$= 0000\ 0000\ 0000\ 1000$

1.01000×10^{-3}

Sign = 1

E' = 127 - 3 = 124

124_{10} : 2|124
2|62 r0
2|31 r0
2|15 r1
2|7 r1
2|3 r1
2|1 r1
2|0 r1

$= 0111\ 1100$

Frac: 0100 0000

$= 0111\ 1100_{(2)}$

1	0111 1100	010 0000 0000 0000 0000 0000
Sign	E'	Fraction (IEEE-754)

$= 1011\ 1110\ 0010\ 0000\ 0000\ 0000\ 0000\ 0000$

$=$ B E 2 0 0 0 0 0

$=$ 0X BE20 0000 (16).

8(a) $0XC1DEC000_{(16)}$

$= 0x\ 12\ 1\ 13\ 14\ 12\ 0\ 0_{(10)}$

$= 0x\ 1100\ 0001\ 1101\ 1110\ 1100\ 0000\ 0000_{(2)}$

$= \frac{1}{\text{Sign}}\ \frac{1000\ 0011}{E'}\ \frac{101\ 1110\ 1100\ 0000\ 0000\ 000}{\text{Fraction}}$

Sign = -1

$1000\ 0011_{(2)} \Rightarrow 131_{10} = E'$

$E = E' - 127 = 131 - 127 = 4$

$\Rightarrow -1.101\ 1101\ 1000 \times 2^{4}$

$= -11011.11011_{(2)}$
16 8 4 2 1 . 0.5 0.25 0.125 0.0625

Decimal $= -[(1 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) + (1 \times 2^1) + (1 \times 2^0)$

$= -(16 + 8 + 0 + 2 + 1) = -27$

Fraction : $(1 \times 2^{-1}) + (1 \times 2^{-2}) + (0 \times 2^{-3}) + (1 \times 2^{-4}) + (1 \times 2^{-5})$

$= 0.84375$

$\therefore \Rightarrow -27.84375_{(10)}$.

(b) 0x 3EA8 0000 (16)

3 14 10 8

= 0011 1110 1010 1000 0000 0000 0000 0000 (2)

Sign E' Fraction

E' = 0111 1101 (2) = (1×64)+(1×32)+(1×16)+
(1×8)+(1×4)+(0×2)+(1×

= 64+32+16+8+4+0+1

= 125

E' = E+127 1.0101 × 2^{-2} = 0.01 01 01
2^{-2} 2^{-4} 2^{-6}

E = E'-127 =) = (1×2^{-2})+(1×2^{-4})
+(1×2^{-6})

= 125-127 = 0.328125 (10).

= -2.