

① Lab 7

1.) IEEE 745 SP: 0x40C80000

Binary: 0100 0000 1100 1000 0000 0000 0000 0000
 SB exponent mantissa

Sign Bit: 0
 Sign ~~num~~: +1

Exponent Bits: 1000 0001
or 8

$$8 \cdot 16^1 + 1 \cdot 16^0 = 128 + 1 = 129 - \underbrace{127}_{\text{shift}} = 2$$

Real exponent factor: 2^2

Significand bits: 100 1000 0000 0000 0000 0000

Hex value: 0x480000

$$8 \cdot 16^4 + 4 \cdot 16^5 = 4718592_{10}$$

Significand:

<u>1.</u>	<u>1001</u>	$= 1 + \frac{1}{2} + \frac{1}{16}$	$= 1 + \frac{8}{16} + \frac{1}{16} = 1 \frac{9}{16} = 1.5625$
<u>$\frac{1}{2}$</u>	<u>$\frac{1}{16}$</u>		

IEEE 745 SP: 0xbC4CCCCC

Binary: 1011 1100 0100 1100 1100 1100 1100 1100

Sign Bit: 1

Sign: -1

Exponent Bits: 0111 1000
or 7 8

$$7 \cdot 16^1 + 8 \cdot 16^0 = 120 - \underbrace{127}_{\text{shift}} = -7$$

Real exponent factor: 2^{-7}

0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A10	1010
B11	1011
C12	1100
D13	1101
E14	1110
F15	1111

2) Significand bits: 100 1100 1100 1100 1100 1100

Significand: $1. \underbrace{100}_{\frac{1}{2}} \underbrace{1100}_{\frac{1}{16} \frac{1}{32}} = 1 + \frac{1}{2} + \frac{1}{16} + \frac{1}{32} = 1 \frac{19}{32} = 1.59375$

IEEE 745 SP: 0x41233333

Binary: 0100 0001 0010 0011 0011 0011 0011 0010

Sign bit: 0

Sign: +

Exponent bits: $\begin{array}{cc} \overbrace{1000} & \overbrace{0010} \\ \text{Or} & \\ 8 & 2 \end{array}$

$$8 \cdot 16^1 + 2 = 130 - \underbrace{127}_{\text{shift}} = 3$$

Real exponent factor: 2^3

Significand bits: 0100 0100 0110

Significand: $1. \underbrace{0100}_{\frac{1}{4}} \underbrace{0100}_{\frac{1}{16}} \underbrace{0110}_{\frac{1}{32} \frac{1}{1024}} = 1 + \frac{1}{4} + \frac{1}{16} + \frac{1}{32} + \frac{1}{1024} = 1.27637$

IEEE 745 SP: 0x3d800000

Binary: 1011 1101 1000 0000 0000 0000 0000 0000

Sign bit: 1

Sign: -

~~Exponent bits: 0111 1011~~

Real exponent factor: 2^{-4}

$$-4 + 127 = 123_{10} = 1111011_2$$

Significand bits: 0000 0000

Significand: 1.0

$$\begin{array}{r} 123 \\ 2 \overline{)123} \\ 2 \overline{)61} \quad R_1 \\ 2 \overline{)30} \quad R_1 \\ 2 \overline{)15} \quad R_0 \\ 2 \overline{)7} \quad R_1 \\ 2 \overline{)3} \quad R_1 \\ 2 \overline{)1} \quad R_1 \\ 2 \overline{)0} \quad R_1 \end{array}$$

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IEEE 745 SP:	0x40c80000	0xb01cccc0	0x41233333	0x3d8000
Sign Bit:	0	1	0	1
Sign (+/-)	+1	-1	+1	-1
Exponent Bits	1000 0001	0111 1000	1000 0010	0011 1011
Real Exp Factor	2 2^2	2 2^{-7}	2^3	2^{-4}
Significand Bits	1001 0000	100 1100 1100	0100 0110 0110	0000 0000
Significand.	1.5625	1.59375	1.27637	1.0

1a.) 0x40866666

Binary: 0100 0000 1000 0110 0110 0110 0110 0110

$$\text{Exp: } \begin{matrix} 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 2^7 & & & & & +2^0 & \end{matrix} = 129_{10} - 127 = \boxed{2}$$

shift

Mantissa: ~~0000 0110 0110~~

$$2^{-3} + 2^{-6} = 0.046875 \approx \boxed{1.046875 \times 10^2} \approx \boxed{4.1875}$$

1b.) 0x46ff0000

Binary: 0110 0110 1111 1111 0000 0000 0000 0000

$$\text{Exp: } \begin{matrix} 1 & 1 & 0 & 0 & 1 & 1 & 0 & 1 \\ 2^9 & +2^6 & +2^3 & +2^2 & +2^0 & & & \end{matrix} = 205 - 127 = \boxed{78} \quad 2^{78}$$

Mantissa: 1111 1110 0000 ~~0000~~

$$2^{-1} + 2^{-2} + 2^{-3} + 2^{-4} + 2^{-5} + 2^{-6} = 0.984375$$

$$1.984375 \times 2^{78} \approx \boxed{6 \times 10^{23}}$$

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$$2a) -1.600. \underline{\underline{6666}}$$

SB: 1

Exp: ~~00000000~~

$$10 + 127 = 137 \\ 2^7 + 2^3 + 2^0 = \boxed{100010001}$$

$$\begin{array}{r} 2 | 1600 \\ 2 | 800 \quad R0 \\ 2 | 400 \quad R0 \\ 2 | 200 \quad R0 \\ 2 | 100 \quad R0 \\ 2 | 50 \quad R0 \\ 2 | 25 \quad R0 \\ 2 | 12 \quad R1 \\ 2 | 6 \quad R0 \\ 2 | 3 \quad R0 \\ 2 | 1 \quad R1 \\ 0 \quad R1 \end{array}$$

$$\cdot 6666 \times 2 = \boxed{1} \underline{\underline{3333}} \\ \cdot 3333 \times 2 = \boxed{0} \underline{\underline{6666}}$$

11001000000. ~~1000~~ 10X 2⁰

$$1. \boxed{10010000001010} \times 2 \\ \text{mantissa}$$

Binary: 1100 0100 1100 1000 0001 0101 0101 0101

SP FP: 0x4C81555

$$2b) -1.6 \times 10^{-19}$$

SB = 1

1. 1001 .

decimal mantissa from calculator: 1.4757

$$\log_2(1.6 \times 10^{-19}) = -63$$

$$-63 + 127 = \boxed{64_{10}} = 0100 0000_2$$

~~$$0.8 \times 2 = 1.2$$

$$0.2 \times 2 = 0.4$$

$$0.4 \times 2 = 0.8$$

$$0.8 \times 2 = 1.6$$

$$0.6 \times 2 = 1.2$$~~

$$0.4757 \times 2 = \boxed{0.9514}$$

$$0.9514 \times 2 = \boxed{0.9028}$$

$$0.9028 \times 2 = \boxed{1.8056}$$

$$0.8056 \times 2 = \boxed{1.6112}$$

1. 0111

Binary: 1010 0000 0011 1000 0000 0000 0000 0000

0x40380000

$$\textcircled{5} \quad 3a.) \quad \underbrace{0x44800000}_X + \underbrace{0x3f000000}_Y$$

$$X = 0x44800000: 0100\ 0100\ 1000\ 0000\ 0000\ 0000\ 0000\ 0000$$

$$S=0$$

$$Exp = 1000\ 1001$$

$$2^7 + 2^3 + 2^0 = 137 - 127 = 10$$

Mantissa: 1.0000

$$X = 1.0 \times 2^{10}$$

$$Y = 0x3f000000: 0011\ 1111\ 0000\ 0000\ 0000\ 0000\ 0000\ 0000$$

$$S=0$$

$$Exp = 0111\ 1110 = 126 - 127 = -1$$

Mantissa: 1.0000

$$1.0 \times 2^{10} \\ + 1.0 \times 2^{-1}$$

$$10 + 127 = 137_{10} = 1000\ 1001_2$$

~~$$1.0 \times 2^{10} \\ + .000000000001 \\ \hline 1.000000000001 \times 2^{10}$$~~

Mantissa: 0000 0000 0001 0000 0000

$$\text{Binary: } 0100\ 0100\ 1000\ 0000\ 0000\ 0000\ 0000\ 0000$$

$$\begin{array}{cccccccccc} & 4 & 4 & 8 & 0 & 8 & 8 & 0 & 0 \\ \hline & 1 & 0 & & & & & & \end{array}$$

0x44800000

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Q. 3b.) $\underbrace{0x3c0bbb6b}_{X} + \underbrace{0x3c111111}_{Y}$

$$X = 0x3c0bbb6b = \underbrace{0011 1100 0000}_{\text{Exp}} \underbrace{1011 1011 1011 1011}_{\text{Mantissa}}$$

$$S=0$$

$$\text{Exp} = 0111 1000 = 2^6 + 2^5 + 2^4 + 2^3 = 120 - 127 = -7$$

$$\text{Mantissa} = 0001 0111 0111 \underline{0111}$$

$$1.0001 0111 \underline{0111} \times 2^{-7}$$

$$Y = 0x3c111111 = \underbrace{0011 1100 0001}_{\text{Exp}} \underbrace{0001 0001 0001 0001}_{\text{Mantissa}}$$

$$S=0$$

$$\text{Exp} = 0111 1000 = 2^6 + 2^5 + 2^4 + 2^3 = 120 - 127 = -7$$

$$\text{Mantissa} = 0010 0010 \underline{0010}$$

~~$$1.0010 \underline{0010} \times 2^{-7}$$

$$+ 1.0001 \underline{0111} \times 2^{-7}$$

$$\hline 10.0011 1001 \times 2^{-7}$$~~

$$\begin{array}{r}
 1.0010 \underline{0010} \times 2^{-7} \\
 + 1.0001 \underline{0111} \times 2^{-7} \\
 \hline 10.0011 1001 \times 2^{-7} \\
 \boxed{1.0001 11001 \times 2^{-6}}
 \end{array}$$

Binary: ~~01001100100011100100000000000000~~

$$0011 1100 1000 1110 0100 0000 0000 0000$$

$$-6 + 127 = 121_{10}$$

$$0111 1001_2$$

$$3 \quad C \quad 8 \quad E \quad 4 \quad 0 \quad 0 \quad 0$$

$$\boxed{0x3C8E4000}$$

(pg 7) 3c.) $0x42c80000 + 0xc1f80000$

$$x = 0x42c80000 = \underline{0100\ 0010\ 1100\ 1000} 0000\ 0000\ 0000\ 0000$$

$S=0$

$$Exp = 1000\ 0101 = 2^7 + 2^0 + \underbrace{2^2}_5 = 133 - 127 = 6$$

Mantissa: 1001 0000 0000

$$1.1001 \times 2^6$$

$$y = 0xc1f80000 = \underline{1100\ 0001\ 1111\ 1000} 0000\ 0000\ 0000\ 0000$$

$S=\cancel{0}1$

$$Exp = 1000\ 0011 = 2^7 + 2^1 + \underbrace{2^0}_3 = 131 - 127 = 4$$

Mantissa: 1111 0000 0000

$$-1.1111 \times 2^4$$

~~$$\begin{array}{r} 1.1111 \times 2^6 \\ + 1.100100 \times 2^6 \\ \hline 1.000101 \times 2^6 \end{array}$$~~

~~$$\begin{array}{r} -0.01111 \times 2^6 \\ + 1.100100 \times 2^6 \\ \hline 1.000101 \times 2^6 \end{array}$$~~

~~$$\begin{array}{r} 1.100100 \\ - 0.011111 \\ \hline 1.088989 \end{array} \Rightarrow \begin{array}{r} 1000100 \\ + 000001 \\ \hline 1000101 \end{array}$$~~

$SB=0$

$$Exp = 6 + 127 = 133_{10} = 1000\ 0101_2$$

Mantissa: 0001 0100 0000

Binary: 0100 0000 1000 0000 0000 0000 0000 0000

~~0000 0000 0000 0000 0000 0000 0000 0000~~

0x4280000

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4a) $0 \times \underbrace{1100000}_{x}$

$\bullet 0 \times \underbrace{1100000}_{y}$

$$x = 0 \times 1100000 = 0011 \ 1011 \ 0110 \ 1011 \ 1011 \ 1011 \ 1011 \ 1011$$

$$SB = 0$$

$$Exp = 0111 \ 0110 \\ 2^6 + 2^5 + 2^4 + 2^2 + 2^1 = 118 - 127 = -9$$

$$\text{Mantissa} = 1101 \ 0111 \ \underline{0111}$$

$$1.1101 \ 0111 \ \underline{0111} \times 2^{-9}$$

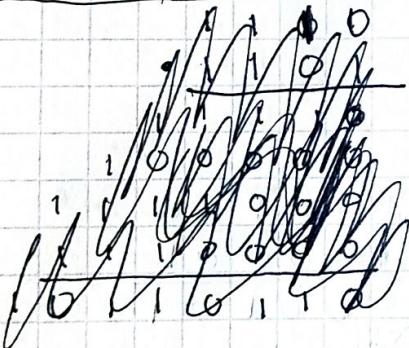
$$y = 0 \times 1100000 = 1100 \ 0010 \ 1111 \ 0000 \ 0000 \ 0000 \ 0000 \ 0000$$

$$SB = 1 \quad Exp = 1000 \ 0101$$

$$2^7 + 2^2 + 2^0 = \underbrace{2^7}_{5} + 2^2 + 2^0 = 133 - 127 = 6$$

$$\text{Mantissa: } 1110 \ 0000 \ \underline{0000}$$

$$-1.1110 \times 2^6$$



$$SB = 1$$

$$Exp = -2 + 127 = 125_{10} = 0111101_2$$

$$\text{Mantissa: } 1011 \ 1001 \ 1000 \ \underline{0000}$$

$$\text{Binary: } 10111110 \ 1101 \ 1100 \ 1100 \ 0000 \ \underline{0000}$$

0xbedcc000

$$\begin{array}{r} 1.1110 \\ \times 1.1101 \\ \hline 1011110 \\ 1000000 \\ 1011110000 \\ 111100000 \\ \hline 1.0111100110 \end{array} \times 2^{-3}$$

$$1.1011 \times 2^{-2}$$

1001

10

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34b.) 0x44000000

• 0x3b00 0000

$$X = 0x44000000 = 0100 0100 0000 0000 0000 0000 0000 0000$$

$$SR = 0$$

$$Exp = 1000 1000 = 2^7 + 2^3 = 136 - 127 = 9$$

$$\text{Mantissa} = \underline{0000}$$

$$1.00 \times 2^9$$

$$y = 0x3b000000 = 0011 1011 0000 0000 0000 0000 0000 0000$$

$$SR = 0$$

$$Exp = 0111 0110 = 2^6 + 2^5 + 2^4 + 2^2 + 2^1 = 118 - 127 = -9$$

$$\text{Mantissa} = \underline{0000}$$

$$1.00 \times 2^{-9}$$

$$0 + 127 = 127 = 0111 1111_2$$

$$1.00 \times 2^{-9}$$

$$\underline{1.00 \times 2^9}$$

$$\begin{array}{r} 0 \\ 0 \\ 0 \end{array}$$

$$000 \times 2^0$$

$$\begin{array}{r} 1.000 \\ . \\ 000 \end{array}$$

$$1.000 \times 2^0$$

$$\text{Mantissa} = \underline{0000}$$

$$\text{Binary} = 0011 1111 1000 0000 \underline{0000}$$

$$\boxed{0x3f800000}$$