Lab 7

Tuesday, March 13, 2018 18:58

1. Copy the table and fill in the blanks

Process of this table is to the right ⇒

IEEE 745 SP	① 0x40C80000	② 0xbc4ccccc	③ 0x41233333	④ 0xBD800000
Sign bit (0 or 1)	0	1	0	1
sign (+/-):	+	-	+	-1
Exponent bits (8-bit binary)	10000001	01111000	10000010	01111011
Real exponent factor	2^2	2^{-7}	2^3	2^{-4}
Significand bits	1001 0000	100 1100 1100	0100 0110 0110	0000 0000
significand	1.5625	1.5996	1.2656	1.0

① 0 100 0000 1 100 1000 0000 0
sign: positive; exponent; significand bits
exponent: $2^7+2^0-127=2 \Rightarrow 2^2$
② 1 01111000 10011001100 1100
sign bit: negative. significand bits
exponent: 120 − 127 = −7 ⇒ 2^{-7}
Significand: $1.2^{-1}+2^{-4}+2^{-5}+2^{-8}+2^{-9}) = 1.599$

③ 0 100 0001 0 10 0011 0011 0
sign: positive. 0x41233333
exponent factor: $(2^7+2)-127=130-127=3 \Rightarrow 2^3$
Significand: $1+(2^{-2}+2^{-4}) = 1.2656$
④ Real expo factor: −4 ⇒ 127 − 4 = 123 (01111011)₂ → exponent bits
Sign is negative, so the sign bit is 1.
The significand is 0, so the significand bits are 0000 0000.
∴ the IEEE 754 SP = 0xBD800000

1. Convert the following .....

a) 0x40866666

b) 0x66ff0000

a). 0x 40866666
sign bit
binary: 0 10000001 000 0110 0110
Exponent: $2^7+2^0=129$
bias = $2^7-1=127$
Exponent − bias = 129 − 127 = 2
∴ Sign 1. Significand $\times 2^{(exp-bias)}$
$= 1.0000\times 2^2$
$= 4\times 10^0$

b) 0x 66ff0000
binary: 0 11001100 111 1111 0000 0000
sign
Exponent: 205
bias: 127
Exponent − bias = 78
∴ Sign. 1. Significand $\times 2^{(exp-bias)}$
$= 1.9922\times 2^{78}$
$= 6.1211\times 10^{23}$

2a) −1600.6666

Convert to binary: 1100 1000000

1600/2 = 800 rem 0
800/2 = 400 rem 0
400/2 = 200 rem 0
200/2 = 100 rem 0
100/2 = 50 rem 0
50/2 = 25 rem 0
25/2 = 12 rem 1
12/2 = 6 rem 0
6/2 = 3 rem 0
3/2 = 1 rem 1

0.6666×2 = 1.3333
0.3333×2 = 0.6666
Since 6 is repeating, the binary form should be 10 10

1100 1000000

$1.1001000000\,10\,10\times 2^{10}$

127+10 = 137 ⇒ 1000 1001 (8-bit binary)

1100 0100 1100 1000 0001 0101 0101 0101
C 4 C 8 1 5 5 5

Answer: 0xC4C81555

2b) -1.6×10^{-19}

Exponent: 127 + (−19) = 108 ⇒ 01101100 (8-bit binary form)

0.6 − 2^{-1} = 1
0.1 − 2^{-2} = 0
0.1 − 2^{-3} = 0
0.1 − 2^{-4} = 1
0.0275 − 2^{-5} = 1
0.00625 − 2^{-6} = 0
0.00625 − 2^{-7} = 0
0.00625 − 2^{-8} = 1

Significand: 1001 1001 1011 0110 0100 1100 1100
B 6 4 C

Answer: 0xB64CCCCC

3a) 0x44800000 + 0x3f000000

Convert to binary first: ① 0x44800000 = 0100 0100 1000 0000 ....
② 0x3f000000 = 0011 1111 0000 .....

① Exponent: 1000 1001 ⇒ 137 − 127 = 10 ⇒ 1.0000×2^{10}
② Exponent: 0111 1110 ⇒ 126 − 127 = −1 ⇒ 1.0000×2^{-1} ⇒ $0.0000000001\times 2^{10}$

1.0000 0000 000 $\times 2^{10}$

$+$ 0.0 0000 0000 001 $\times 2^{10}$

1.0000 0000 001 $\times 2^{10}$ $\Rightarrow$ 10 + 127 = 137 $\Rightarrow (10001001)_2$

0 | 100 0100 | 1000 0000 0001

4 4 8 0 1

Answer: 0x44801000

3b) ① 0x3c0bbbbbb + ② 0x3C111111

Convert to binary: ① 0 0011 1100 0000 1011 1011 1011 1011 1011

exponent: 0111 1000 $\Rightarrow$ 120-127 = -7 $\Rightarrow$ 1.0000 1011 1011 1011 1011 1011 1011 $\times 2^{-7}$

② 0011 1100 0001 0001 0001 0001 0001 0001

exponent: 0111 1000 $\Rightarrow$ 120-127 = -7 $\Rightarrow$ 1.0010 0010 0010 0010 0010 0010 0010 $\times 2^{-7}$

1.0001 0111 0111 0111 0111 0111

$+$ 1.0010 0010 0010 0010 0010 0010

1.0 0011 1001 1001 1001 1001 1001 $\times 2^{-8}$ $\Rightarrow$ -8+127 = 119 $(01110111)_2$

0011, 1011, 1000 1110 0110 0110 0110 0110 ...

3 B 8 E 6 6

Answer: 0x3B8E6666

3c) ① 0x42C80000 + ② 0xC1f80000

Convert to binary: ① 0 0100 0010 1100 1000 0000 ....

exponent: 1000 0101 $\Rightarrow$ 133-127 = 6 $\Rightarrow$ 1.1001 0000 0000 $\times 2^6$

② 1 100 0001 1111 1000 0000 0

exponent: 1000 0011 $\Rightarrow$ 131-127 = 4 $\Rightarrow$ 1.1111 0000 $\times 2^4$ $\Rightarrow$ 0.0111 1100 0000.. $\times 2^6$

The sign of ② is negative, so:

1.1001 0000 0000 ... 0 $\times 2^6$

$-$ 0.0111 1100 0000 .... 0 $\times 2^6$

0.1000 1 0000 ... 0 $\times 2^6$ $\Rightarrow$ 6+127 = 133 $(10000101)_2$

0 | 100 0010 | 1100 0110 0000 0

4 2 C 6 0

Answer: 0x42C60000

4a) ① 0x3bbbbbbb x ② 0xC2f00000

Convert to binary: ① 0 0111 0111 0111 0111 0111 .. 1011

exponent: 0111 0111 $\Rightarrow$ 118 - 127 = -9 $\Rightarrow$ 1.1101 0111 0111 0111 .. 0111 $\times 2^{-9}$

② 1100 0010 1111 0000 0

exponent: 10000101 $\Rightarrow$ 133 - 127 = 6 $\Rightarrow$ 1.1110 0000 $\times 2^6$

1.1101 0111 0111 0111 0111 011

$\times$ 1.1110 0... 0

1.1101 0111 0111 0111 0111 1011

1.1101 0111 0111 0111 0111 1011

1.1101 0111 0111 0111 0111 1011

1.1101 0111 0111 0111 0111 1011

11.0111 0011 1111 1111 1111 1111 1010 1

$2^{-9} \times 2^6 = 2^{-9+6} = 2^{-3}$ $\Rightarrow$ 1.1011 1001 1111 1111 1111 1111 1010 1 $\times 2^{-3}$

Exponent: 127 + -3 = 125 $\Rightarrow$ 0111 1101

1011 1110, 1101 1100 1111,

B C D E F

Answer: 0xBCDEFFFF

4b) ① 0x44000000 x ② 0x3b000000

Binary: ① 0100 0100 0000 .....

exponent: 1000 1000 $\Rightarrow$ 136 - 127 = 9 $\Rightarrow$ 1.000... 0 $\times 2^9$

② 0011 1011 000 0

exponent: 0111 0110 $\Rightarrow$ 118 - 127 = -9 $\Rightarrow$ 1.000... 0 $\times 2^{-9}$

The result of multiplication is $1.0 \times 2^{0} \Rightarrow 1.0$

Exponent: $0+127=127$ $(01111111)_2$

0011,1111,1000,0000,....

↓ ↓ ↓

3 F 8 0

Answer: 0x3F800000