

①

0111 x 1100

it	step	multiplier	multiplier	product
0	initialize values	1100	0000 0111	0000 0000
1	multiplier = 0 1) multiplier << 1 2) multiplier >> 1	0110	0000 1110	0000 0000
2	multiplier = 0 1) multiplier << 1 2) multiplier >> 1	0011	0001 1100	0000 0000
3	multiplier = 1 1) mCand + product 2) mCand << 1 3) multiplier >> 1	0001	0011 1000	0001 1100
4	multiplier = 1 1) mCand + product 2) mCand << 1 3) multiplier >> 1	0000	0111 0000	0101 0100
5	multiplier = 0 1) mCand << 1 2) multiplier >> 1	0000 0011	1111 0000	0101 0100
6	multiplier = 0 1) mCand << 1 2) multiplier >> 1	0000 0001	1100 0000	0101 0100
7	multiplier = 0 1) mCand << 1 2) multiplier >> 1	0000 0000	1000 0000	0101 0100
8	multiplier = 0 1) mCand << 1 2) multiplier >> 1	0000 0000	0000 0000	0101 0100

s.a.m

① 0000 1001 / 0010

②

it	step	quotient	divisor	remainder
0	initialize	0000	0010 0000	0000 1001
1	rem = rem - div rem < 0 → +div Q < 1 → Q = 0 div >> 1	0000 0000	0010 0000 0001 0000	1110 1001 0000 1001
2	rem = rem - div rem < 0 → +div Q < 1 → Q = 0 div >> 1	0000 0000	0010 0000 0000 1000	1111 1001 0000 1001
3	rem = rem - div rem < 0 Q < 1 → Q = 1 div >> 1	0000 0001	0000 1000 0000 0100	0000 0001 0000 0001
4	rem = rem - div rem < 0 → +div Q < 1 → Q = 0 div >> 1	0001 0010	0000 0100 0000 0010	1111 1101 0000 0001
5	rem = rem - div rem < 0 → +div Q < 1 → Q = 0 div >> 1	0010 0100	0000 0010 0000 0001	1111 1111 0000 0001
Final		0100	0000 0001	0000 0001

$$-0.63_{ten} = 0.63 \times 2 = 1.26, 0.26 \times 2 = 0.52$$

(3)

$$\Rightarrow -0.10 \Rightarrow -0.1 \times 2^0 \xrightarrow{\text{normalize}} -1 \times 2^{-1}$$

$$(-1)^S \times (1 + \text{Fraction}) \times 2^{(\text{Exponent} - 127)} \quad ; \text{Single}$$

$$\text{Fraction} = 0.0000 \ 0000 \ 0000 \ 0000 \ 0000 \ 0000$$

$$\text{Exponent} = 126 \Rightarrow (-1) \times (1.0000 \ 0000 \ 0000 \ 0000 \ 0000 \ 0000) \times 2^{(126 - 127)}$$

S, Exponent, Fraction

$$\text{Single: } 1 \ 01111110 \underbrace{0000 \ 0000 \dots 00}_{23}$$

$$\text{double: } 1 \ 0111111110 \underbrace{0000 \ 0000 \dots 00}_{52}$$

(4)

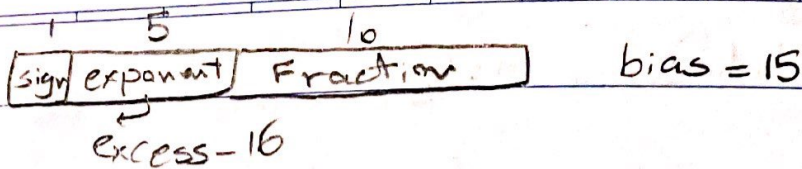
$$7.989 \times 10^2 + 2.310 \times 10^{-1}$$

$$7.989 \times 10^2 = 798.9 \rightarrow 110011110.111$$

$$\Rightarrow 1.1 \times 2^{-8} + 1 \times 2^{-3} = 0.000011 \times 2^{-3} + 1 \times 2^{-3}$$

$$\Rightarrow 1.000011 \times 2^{-3} \approx 1 \times 2^{-3} \Rightarrow 0.125 = 1.25 \times 10^{-2}$$

sam



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$$-1.5625 \times 10^{-1} = -0.15625 \xrightarrow{\text{binary}} -0.001$$

$$0.15625 \times 2 = 0.3125, \times 2 = 0.625, \times 2 = 1.25$$

$$\Rightarrow -1 \times 2^{-3} \quad \text{sign bit} = 1 \quad \text{Fraction} = 0$$

$$\text{exponent} - 15 = -3 \rightarrow \text{exponent} = 12 \rightarrow \begin{array}{r} 01100 \\ +10000 \\ \hline 11100 \end{array}$$

$$\Rightarrow 11100000000000000000000000000000$$

range single precision: smallest = $\pm 1.0 \times 2^{-126}$
 largest = $\pm 2.0 \times 2^{127}$

range in this case:

smallest: exponent = 0001 $\rightarrow 1 - 15 = -14$
 sign and = 1 $\Rightarrow \pm 1.0 \times 2^{-14}$

largest: exponent = 11110 $\rightarrow 30 - 15 = 15$

significand = 2.0 $\Rightarrow \pm 2.0 \times 10^{+15}$

1 7 8
6) Sign exponent Fraction

a → vector 16
in → b → vector 16

out → vector 16

if $a(16) = 0$ & $b(16) = 1$ $s = 1$

else if $a(16) = 1$ & $b(16) = 0$ $s = 1$

else $s = 0$

exponent + exponent = e

Fraction × Fraction = f

while $f > 1$: $e + 1$
 $f - 1$