Barnsley Capleur

Float | 1-bit sign
8-bit exponent
23-bit mantissa

$\text{sign}(1 + \text{mantissa})\ 2^{\text{exponent}-127}$

Range: -3.4×10^{38} to 3.4×10^{38}

Maximum: $\pm 3.4 \times 10^{38}$

Minimum: $\pm 1.17 \times 10^{-38}$

Range

max 0 11111110 1111...1 23, 1s
min 1

sign | 0 → +
1 → −

Exponent | $2^7 + 2^6 + \ldots + 2 + 0 = 254$

Mantissa | $2^{-1} + 2^{-2} + \ldots + 2^{-23} = \sum_{i=1}^{23} \left(\frac{1}{2}\right)^i = 1 - \frac{1}{2^{23}}$

$$\pm\left(1 + 1 - \frac{1}{2^{23}}\right) \cdot 2^{254-127} = \pm 3.4 \times 10^{38}$$

Minimum/smallest

complement of max range

0 0000001 000...0 23, 0s
1

sign | 0 → +
1 → −

Exponent | $0 + \ldots + 2^0 = 1$

Mantissa | $0 + \ldots + 0 = 0$

$$\pm(1 + 0)\ 2^{1-127} = \pm 1.175494944 \times 10^{-38}$$

Double | 1-bit sign
11-bit exponent
52-bit Mantissa

Range: -1.7×10^{308} to 1.7×10^{308}

Greatest: $\pm 1.7 \times 10^{308}$

Smallest: $\pm 2.2 \times 10^{-308}$

Range

max 0 11111111110 1...1 52, 1s
min 1

sign | 0 → +
1 → −

Exponent | $2^{10} + 2^9 + \ldots + 2 + 0 = 2046$

Mantissa | $2^{-1} + \ldots + 2^{-52} = 1 - \frac{1}{2^{52}}$

$$\pm\left(1 + 1 - \frac{1}{2^{52}}\right) \cdot 2^{2046-1023} = \pm 1.7 \times 10^{308}$$

Smallest

0 00000000001 0...0 52, 0s
1

sign | 0 → +
1 → −

Exponent | $0 + \ldots + 2^0 = 1$

Mantissa | $0 + \ldots + 0 = 0$

$$\pm(1 + 0) \cdot 2^{1-1023} = \pm 2.22507 \times 10^{-308}$$