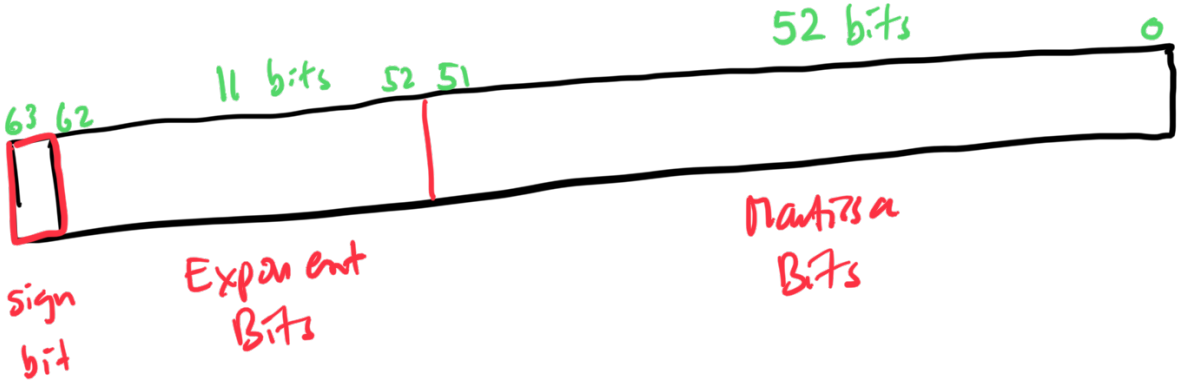
# Double Precision Floating Pt.

## 64 bits (IEEE 754)




$$\text{real value (base 10)} = (-1)^{\text{sign}} \left(1 + \sum_{i=1}^{52} b_{52-i} 2^{-i}\right) \times 2^{e-1023}$$

## Largest #


$\approx 1$

$2^{11} - 1 - 1$

$= 2046$

$$\approx 2 \times 2^{2046-1023}$$

**Double-precision examples** [ edit ]

$0\ 01111111111\ 0000000000000000000000000000000000000000000000000000_2 \triangleq 3FF0\ 0000\ 0000\ 0000_{16} \triangleq +2^0 \times 1 = 1$

$0\ 01111111111\ 0000000000000000000000000000000000000000000000000001_2 \triangleq 3FF0\ 0000\ 0000\ 0001_{16} \triangleq +2^0 \times (1 + 2^{-52}) \approx 1.0000000000000002$, the smallest number > 1

$0\ 01111111111\ 0000000000000000000000000000000000000000000000000010_2 \triangleq 3FF0\ 0000\ 0000\ 0002_{16} \triangleq +2^0 \times (1 + 2^{-51}) \approx 1.0000000000000004$

$0\ 10000000000\ 0000000000000000000000000000000000000000000000000000_2 \triangleq 4000\ 0000\ 0000\ 0000_{16} \triangleq +2^1 \times 1 = 2$

$1\ 10000000000\ 0000000000000000000000000000000000000000000000000000_2 \triangleq C000\ 0000\ 0000\ 0000_{16} \triangleq -2^1 \times 1 = -2$

$0\ 10000000000\ 1000000000000000000000000000000000000000000000000000_2 \triangleq 4008\ 0000\ 0000\ 0000_{16} \triangleq +2^1 \times 1.1_2 = 11_2 = 3$

$0\ 10000000001\ 0000000000000000000000000000000000000000000000000000_2 \triangleq 4010\ 0000\ 0000\ 0000_{16} \triangleq +2^2 \times 1 = 100_2 = 4$

$0\ 10000000001\ 0100000000000000000000000000000000000000000000000000_2 \triangleq 4014\ 0000\ 0000\ 0000_{16} \triangleq +2^2 \times 1.01_2 = 101_2 = 5$

$0\ 10000000001\ 1000000000000000000000000000000000000000000000000000_2 \triangleq 4018\ 0000\ 0000\ 0000_{16} \triangleq +2^2 \times 1.1_2 = 110_2 = 6$

$0\ 10000000011\ 0111000000000000000000000000000000000000000000000000_2 \triangleq 4037\ 0000\ 0000\ 0000_{16} \triangleq +2^4 \times 1.0111_2 = 10111_2 = 23$

$0\ 01111111000\ 1000000000000000000000000000000000000000000000000000_2 \triangleq 3F88\ 0000\ 0000\ 0000_{16} \triangleq +2^{-7} \times 1.1_2 = 0.00000011_2 = 0.01171875\ (3/256)$

$0\ 00000000000\ 0000000000000000000000000000000000000000000000000001_2 \triangleq 0000\ 0000\ 0000\ 0001_{16} \triangleq +2^{-1022} \times 2^{-52} = 2^{-1074} \approx 4.9406564584124654 \times 10^{-324}$ (Min. subnormal positive double)

$0\ 00000000000\ 1111111111111111111111111111111111111111111111111111_2 \triangleq 000F\ FFFF\ FFFF\ FFFF_{16} \triangleq +2^{-1022} \times (1 - 2^{-52}) \approx 2.2250738585072009 \times 10^{-308}$ (Max. subnormal double)

$0\ 00000000001\ 0000000000000000000000000000000000000000000000000000_2 \triangleq 0010\ 0000\ 0000\ 0000_{16} \triangleq +2^{-1022} \times 1 \approx 2.2250738585072014 \times 10^{-308}$ (Min. normal positive double)

$0\ 11111111110\ 1111111111111111111111111111111111111111111111111111_2 \triangleq 7FEF\ FFFF\ FFFF\ FFFF_{16} \triangleq +2^{1023} \times (1 + (1 - 2^{-52})) \approx 1.7976931348623157 \times 10^{308}$ (Max. Double)

$0\ 00000000000\ 0000000000000000000000000000000000000000000000000000_2 \triangleq 0000\ 0000\ 0000\ 0000_{16} \triangleq +0$

$1\ 00000000000\ 0000000000000000000000000000000000000000000000000000_2 \triangleq 8000\ 0000\ 0000\ 0000_{16} \triangleq -0$

$0\ 11111111111\ 0000000000000000000000000000000000000000000000000000_2 \triangleq 7FF0\ 0000\ 0000\ 0000_{16} \triangleq +\infty$ (positive infinity)

$1\ 11111111111\ 0000000000000000000000000000000000000000000000000000_2 \triangleq FFF0\ 0000\ 0000\ 0000_{16} \triangleq -\infty$ (negative infinity)

$0\ 11111111111\ 0000000000000000000000000000000000000000000000000001_2 \triangleq 7FF0\ 0000\ 0000\ 0001_{16} \triangleq$ NaN (sNaN on most processors, such as x86 and ARM)

$0\ 11111111111\ 1000000000000000000000000000000000000000000000000001_2 \triangleq 7FF8\ 0000\ 0000\ 0001_{16} \triangleq$ NaN (qNaN on most processors, such as x86 and ARM)

$0\ 11111111111\ 1111111111111111111111111111111111111111111111111111_2 \triangleq 7FFF\ FFFF\ FFFF\ FFFF_{16} \triangleq$ NaN (an alternative encoding of NaN)

$0\ 01111111101\ 0101010101010101010101010101010101010101010101010101_2 = 3FD5\ 5555\ 5555\ 5555_{16} \triangleq +2^{-2} \times (1 + 2^{-2} + 2^{-4} + \ldots + 2^{-52}) \approx 1/3$

$0\ 10000000000\ 1001001000011111101101010001001000010110100011000_2 = 4009\ 21FB\ 5444\ 2D18_{16} \approx \text{pi}$