$$(-1)^S \times (1 + \text{Fraction}) \times 2^{(\text{Exponent} - \text{Bias})}$$

Hex

Example: Convert each of the following IEEE-754 floating point representation to decimal values.

a. 0x41380000 → 32 bits IEEE-754 single precision format

b. 0xC0E80000

a

0 X 4 1 3 8 0 0 0 0

sign

32 → 0 | 100 0001 | 0011 1000 0000 0000 0000 0000

Exponent | fraction.

$S = 0$

128 21 128+2 = 130

Exponent $= 1000\,0010_2 = 130_{10}$

Bias $= 127$

Fraction $= 0.0111_2 = 0.4375_{10}$

0.8625

Weight:	4	2	1	.	0.5	0.25	0.125
Binary:					0	1	1

0.25 + 0.125 + 0.0625 = 0.4375

b

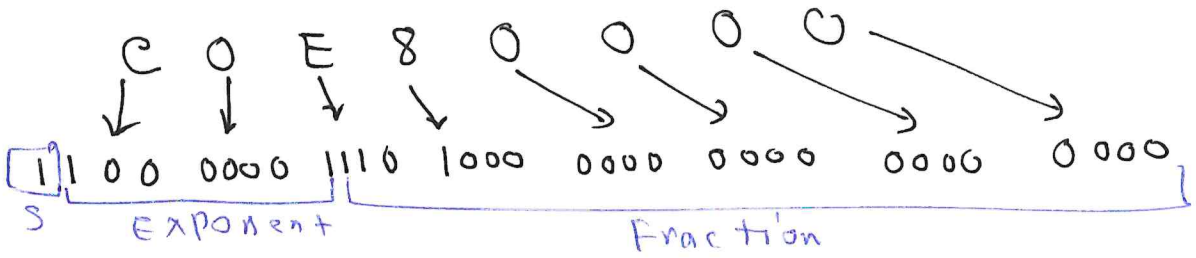
$$\text{Decimal value} = (-1)^S \times (1 + \text{Fraction}) \times 2^{\text{Exponent} - \text{Bias}}$$

$$= (-1)^0 \times (1 + 0.4375) \times 2^{130 - 127}$$

$$= 1.4375 \times 2^3$$

$$= 11.5$$

b $\quad$ 0 x C0E8 0000



$S = 1$.

Exponent $= 1000\,0001_2 = 129$

bias $= 127$

Fraction $= 0.1101_2$

$= 0.8125_{10}$

. 0.5	0.25	0.125	0.0625 .
1	1	0	1

$0.5 + 0.25 + 0.0625 = 0.8125$

$$\text{Decimal Value} = (-1)^S * (1 + \text{Fraction}) * 2^{(\text{exponent} - \text{bias})}$$

$$= (-1)^1 * (1 + 0.8125) * 2^{129 - 127}$$

$$= (-1)\ (1.8125) * 2^2$$

$$= -7.25.$$

3.14

→ 3.1416

IEEE 754 Double Precision Format

S	EXPONENT	FRACTION
1 bit	11 bits	52 bits

→ 64 bit.

- S: Sign bit (0 → Non-negative, 1→ Negative)
- Exponent = Actual Exponent + Bias

  For double precision, Bias = 1023
- Fraction : 52-bit fractions from normalized number

Example: Convert the decimal value 2.75 to IEEE-754 double precision format. Write your converted result in hexadecimal format.

2 . 7 5

Binary point

$2.75_{10} = 10.11_2$

Normalized number. $= 1.011 \times 2^1$

Weight	8	4	2	1	.	0.5	0.25	0.125	0.0625
	1	0	.	1		1			

S = 0

Exponent = 1 + 1023 = 1024_{10} = 100 0000 0000$_2$

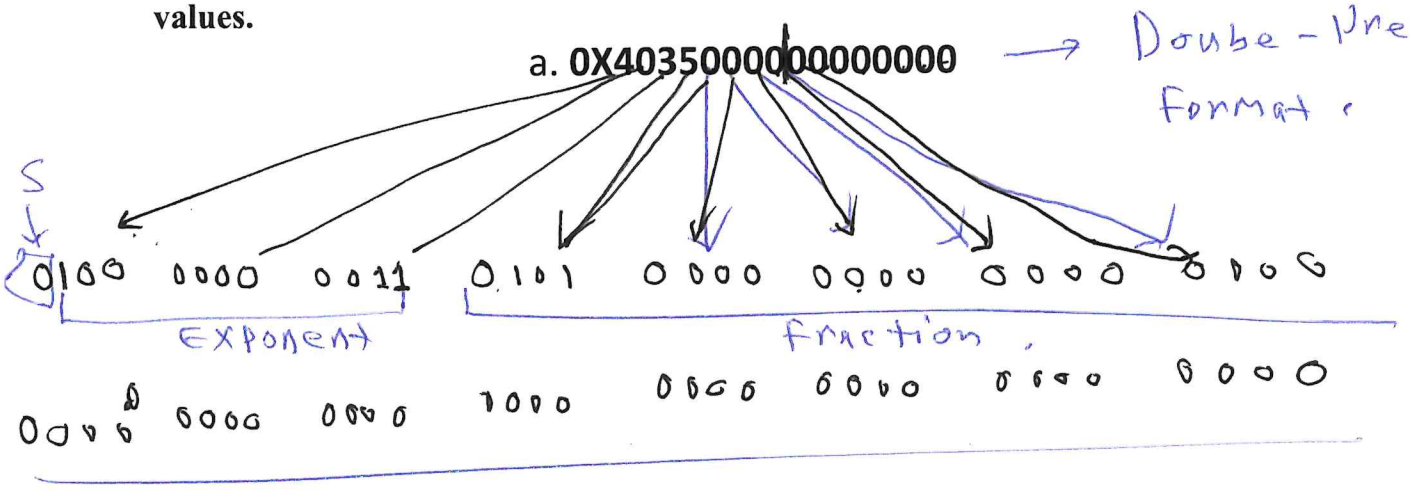
Fraction = 0.011

S	exponent	Fraction
0	100 0000 0000	0110 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
	4 0 0	6 0 0 0 0 0 0 0 0 0 0 0 0

Hex = 0x 4006 0000 0000 0000

Example: Convert the following IEEE-754 floating point representation to decimal values.

a. 0X4035000000000000 → Double-Precision format.



$S = 0$

$1024 + 21$

$EXponent = 100\ 0000\ 0011 = 1027_{10}$

$Fraction = 0.0101_2$

$= 0.3125_{10}$

0.5	0.25	0.125	0.0625
0	1	0	1

$0.25 + 0.0625 = 0.3125$

Decimal Value

$= (-1)^S * (1 + Fraction) \times 2^{exponent - bias}$

$= (-1)^0 * (1 + 0.3125) \times 2^{1027 - 1023}$

$= 1.3125 \times 2^4$.

$= 21$.

The value of the floating-point number can be determined by the following expression:

$$(-1)^S \times (1 + \text{Fraction}) \times 2^{(\text{Exponent} - \text{Bias})}$$

Example: Convert the decimal value -4.25 to IEEE-754 double precision format. Write your converted result in hexadecimal format.

Weight 8 4 2 1 . 0.5 0.25 0.125 0.0625

1 0 0 . 0 1

$-4.25_{10} = -100.01_2$

$= -1.0001 \times 2^2$

1024 512 256 128 64 32 16 8 4 2 1

S = 1 1 0 0 0 0 0 0 0 0 0

exponent = 2 + 1023 = $1025_{10} = 10000000001_2$

Fraction = 0.0001.

S	Exponent	Fraction
1	10000000001	0001000000 . . .