Question-1

Compute the largest and smallest positive numbers that can be represented in the 32-bit normalized form.

Q1.sol :

Largest positive number: S=0, E=1111 1110 (254), F=111 1111 1111 1111 1111 1111.

Smallest positive number: S=0, E=0000 00001 (1), F=000 0000 0000 0000 0000 0000.

Question-2

Compute the largest and smallest negative numbers can be represented in the 32-bit normalized form.

Q2.sol:

Largest negative number: S=1, E=1111 1110 (254), F=111 1111 1111 1111 1111 1111.

Smallest Negative: S=1, E=0000 00001 (1), F=000 0000 0000 0000 0000 0000.

Question-3

find the decimal value of the following IEEE number.

101111111001100000000000000...

First convert each individual field to decimal.

The sign bit s is 1.

The e field contains **01111111** $= 127_{10}$

The mantissa is $0.$**0011**... $= 0.1875_{10}$

Then just plug these decimal values of s, e and f into the formula.

$$(1 - 2s) * (1 + f) * 2^{e\text{-bias}}$$

This gives us

$$(1 - 2) * (1 + 0.1875) * 2^{127-127}$$

$$= (-1.1875 * 2^{0})$$

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Question-4

Test the associativity of the following operation.

$X = -10.1 \times 2^{17}$, $Y = 1.010 \times 2^{18}$, $z = 1.0 \times 2^{-23}$

$X + (Y + Z)$ & $(X + Y) + Z$.

sol : Q4.

Make exponentials of both the numbers equal

$$
\begin{aligned}
X+(Y+Z) &= -10.1\times 2^{17} + (1.010\times 2^{18} + 1.0\times 2^{-23}) \\
&= -10.1\times 2^{17} + (1.010\times 2^{18} + 0.00....1\times 2^{18}) \\
&= -10.1\times 2^{17} + (1.010\times 2^{18}) \\
&= -10.1\times 2^{17} + 10.1\times 2^{17} = 0.
\end{aligned}
$$

$$
\begin{aligned}
(X+Y)+Z &= (-10.1\times 2^{17} + 1.010\times 2^{18}) + 1.0\times 2^{-23} \\
&= 0.0 + 1.0\times 2^{-23} = .00000012.
\end{aligned}
$$

Question-5

Q5. Find the result of following operation :

a) $m = 3.2 \times 10^8 \quad n = 5.8 \times 10^6$

$m \times n = ?$

b) $m = 11.0011 \times 2^{-1} \quad n = -101.1100 \times 2^{-2}$

Sol : Q5 :

a) $m \times n = 3.2 \times 5.8 \times 10^8 \times 10^6$
$= 18.56 \times 10^{14} = 18.56 \times 10^{14}$
$= 1.856 \times 10^{15}$.

b) $m \times n = 1.10011 \times -1.011100$
$= -1.0010100_2 \times 2^1$
$= -1.15625_{10} \times 2^1 = -2.3125_{10}$.

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$= -1.15625_{10} \times 2^1 = -2.3125_{10}$.

Question-7

The IEEE single precision floating point standard allows us to represent less than 2^32 different numbers. Of these numbers:

(a) How many are strictly between 2^{-5} and 2^{-4} ?
(b) How many are strictly between 2^{13} and 2^{14} ?
(c) How many are strictly between 2^{47} and 2^{48} ?

Question-8

Approximate the decimal number 43.00008 as a normalized binary number in scientific notation, with ten bits of significand.