'Assignment-01'

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Sec: 06

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Ans to the que no -01

(a)

The maximum numbers that can be stored in the system by these three forms are following:

Given, $\beta = 2$, $m = 5$ and $-2 \le e \le 5$

So,

Standard form : $(0.11111)_2 \times 2^5 = (31)_{10}$

IEEE Normalized form: $(0.111111)_2 \times 2^5 = \left(\frac{63}{2}\right)_{10} = (31.5)_{10}$

IEEE Denormalized form: $(1.11111)_2 \times 2^5 = (63)_{10}$

(b)

The non-negative minimum numbers that can be stored in the system by the three forms are following:

Standard form: $(0.10000)_2 \times 2^{-2} = \left(\frac{1}{8}\right)_{10} = (0.125)_{10}$

IEEE Normalized form: $(0.100000)_2 \times 2^{-2} = \left(\frac{1}{8}\right)_{10} = (0.125)_{10}$

IEEE Denormalized form: $(1.00000)_2 \times 2^{-2} = \left(\frac{1}{4}\right)_{10} = (0.25)_{10}$

(c)

The range of floating numbers including negative numbers that are considered zero and $\pm\infty$ are:

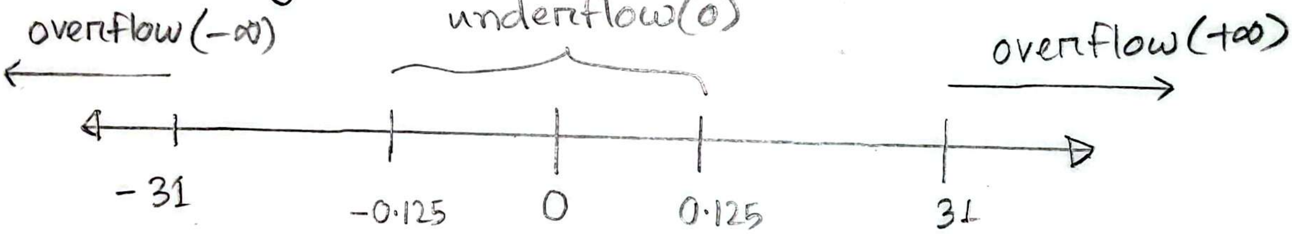
For standard form,

maximum value $= (0.11111)_2 \times 2^5 = (31)_{10}$

minimum value $= -(0.11111)_2 \times 2^5 = -(31)_{10}$

minimum non-negative value $= (0.10000)_2 \times 2^{-2} = \left(\frac{1}{8}\right)_{10} = (0.125)_{10}$

So, the range will be,



So, for any value, that is more than the maximum value is $+\infty$ and less than minimum also is $-\infty$. And, between -0.125 to 0.125 is underflow which will be zero.

$+\infty$ is for more than $(31)_{10}$

$-\infty$ is for less than $(-31)_{10}$

0 is for between $(-0.125)_{10}$ to $(+0.125)_{10}$

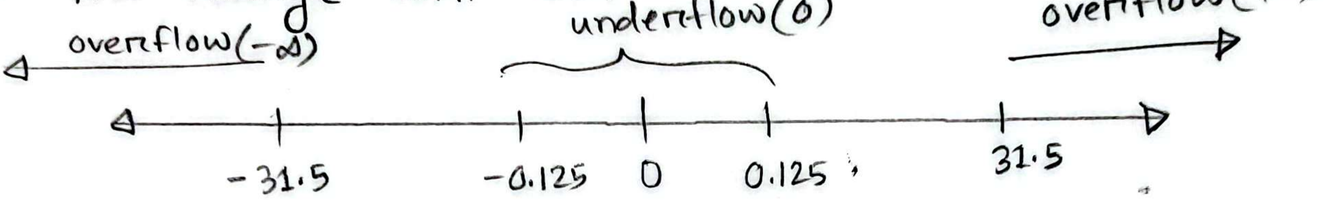
for IEEE Normalized Form,

maximum value $= (0.111111)_2 \times 2^5 = \left(\frac{63}{2}\right)_{10} = (31.5)_{10}$

minimum value $= -(0.111111)_2 \times 2^5 = -\left(\frac{63}{2}\right)_{10} = -(31.5)_{10}$

minimum non-negative value $= (0.100000)_2 \times 2^{-2} = \left(\frac{1}{8}\right)_{10} = (0.125)_{10}$

So, the range will be,



So, $+\infty$ is more than $(31.5)_{10}$

$-\infty$ is for less than $-(31.5)_{10}$

0 is for between $-(0.125)_{10}$ to $+(0.125)_{10}$

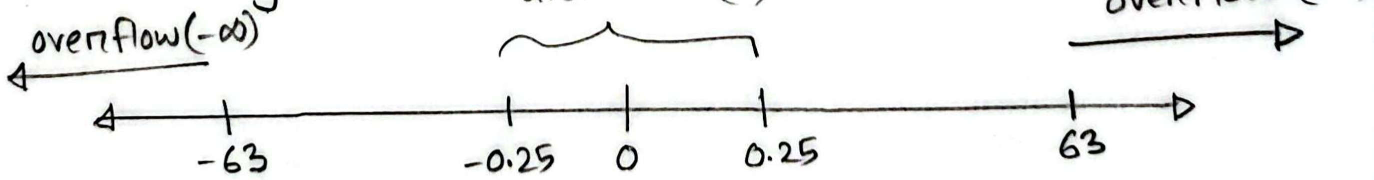
Finally, for IEE Denormalized form,

maximum value $= (1.11111)_2 \times 2^5 = (63)_{10}$

minimum value $= -(1.11111) \times 2^5 = -(63)_{10}$

minimum non-negative value $= (1.00000)_2 \times 2^{-2} = \left(\frac{1}{4}\right)_{10} = (0.25)_{10}$

So, the range is,



we get, $+\infty$ is for more than $(63)_{10}$

$-\infty$ is for less than $-(63)_{10}$

0 is for between $-(0.25)_{10}$ to $+(0.25)_{10}$

Ans to the que. no - 02

(a)

Given equation,

$$x^2 - 60x + 1 = 0$$

we have to calculate upto six significant figures.

So,
if $x_{1,2}$ are two roots of the equation,

$$x_{1,2} = \frac{-(-60) \pm \sqrt{(-60)^2 - 4.1.1}}{2.1}$$

$$= \frac{60 \pm 2\sqrt{899}}{2}$$

$$= 30 \pm \sqrt{899}$$

So, we get, $x_1 = 30 + \sqrt{899}$

$$= 30 + 29.9833$$

$$= 59.9833$$

$$x_2 = 30 - \sqrt{899}$$

$$= 30 - 29.9833$$

$$= 0.0167000$$

We can see that, when calculating x_2 we are subtracting two very close numbers. This is where the loss of significance occurs. (Ans.)

(b)

from (a), we get,

$$x_1 = 59.9833$$

$$x_2 = 0.0167$$

So, two fundamental properties of a polynomial are,

$$x_1 + x_2 = \frac{-b}{a}$$

$$x_1 \cdot x_2 = \frac{c}{a}$$

Firstly,

$$x_1 + x_2 = 59.9833 + 0.0167$$

$$= 60$$

also, from the equation,

$$x_1 + x_2 = \frac{-(-60)}{1} = 60$$

$\therefore$ this satisfies the first property.

Again,

$$x_1 \cdot x_2 = (59.9833) \times (0.0167)$$

$$= 1.00172$$

but, from the equation, we see that,

$$x_1 \cdot x_2 = \frac{1}{1} = 1$$

$\therefore$ this does not satisfy this property.

Finally, we can conclude that, though first property is satisfied, the roots evaluated in the ~~do~~ previous part do not completely satisfy the fundamental properties of a polynomial.

(c)

To evaluate correct roots, we first have to correct x_2 as this is where the loss of significance happens. We know,

$$x_1 \cdot x_2 = \frac{c}{a}$$

$$\Rightarrow \quad x_2 = \frac{c}{a x_1}$$

$$\Rightarrow \quad x_2 = \frac{1}{1 \cdot (59.9833)}$$

$$\Rightarrow \quad x_2 = 0.0166713$$

So, we have $x_1 = 59.9833$ and $x_2 = 0.0166713$

To know that x_2 and x_1 are correct roots that we calculate, let's check the property of polynomial again,

$$x_1 + x_2 = 59.9833 + 0.0166713$$

$$= 60$$

So, the correct roots of the given quadratic equation are,

$$x_1 = 59.9833$$

$$x_2 = 0.0166713$$

(Ans.)