Square Root using Vedic Mathematics a Review

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Abstract:

To get square root of any positive real number we explored a sutra of Vedic Mathematics called "Ekadhikena Purvena". With the help of vivid numbers, we reviewed a newly developed algorithm.

Keywords: Vedic mathematics, square root, real numbers.

1. Introduction:

The depth of the mathematical formulation within the sort of "Sutras" presented by the Indian saints, many years back has not been gauged and explored to the fullest extent. The buried treasure within the Indian mythological statements is so wide and great that they contain absolute perfection which will propel the present science to the good heights. It is well known that Everest is the only one and not many have scaled it, which is surrounded by many other mountains within easy reach. An ultimate without approximation and with real time touch of straightforward mathematics has always say that is attractive sort of a fountain. it is not totally ruled out that efforts aren't made to show the authenticated philosophy of Indian science and arithmetic, But the examples are few even if the profiles are many.

The objective of this paper is to prove an algorithm to get the square root of any given number using the Vedic sutra "Ekadhikena Purvena". Large amount of parallelism exhibited by computational algorithm in its workout and utilization of simple arithemaic operations like +, -, x etc took place. although the algorithm isn't computerized, it is often authorize stated that the formulation can give fastest result. The results obtained are absolute and accurate. In the process 'Y' operator (Yojayet operator) has been defined and utilized, within the algebraic formulation of the sutra, "Ekadhikena Purvena". The inverse of Y (Y^{-1}) eased the method of finding the root. The particular application of the sutra considered, as explained by meditating Swamiji is presented to spotlight the explored potential of the sutra.

2. Formulation of the sutra- "Ekadhikena Purvena"

The literal meaning of the stated sutra discovered from Veda by spiritual Swamiji means "one more than the previous". He applies this sutra successfully for finding the square of a number ending with 5. Suppose if we are to find the square of 65 the previous number is 6. One more than the previous is 7. Multiply 6 and 7 and unite it with square of 5 to get square of 65 equal to 4225. To generalize the statement algebraically, if 't5' is the number to be squared then

$$(t5)^2 = t(t+1) \times 100 + 25 \qquad \textbf{...(1)}$$

a. Operator Y (Yojayet)

By definition Y operator is the combined form of two operations embedded to easily the handling of the sutra. Mathematically it is stated as

$$Y_m = (\times 10^{m-1}) +$$

Hence the statement (1) considering 't' to be a previous number, can be written as

$$(tY_2 5)^2 = t(t+1)Y_3 25 \qquad \textbf{...(2)}$$

For example,

$$4Y_m 8 = 48, \text{ if } m = 2$$

$$= 408, \text{ if } m = 3 \text{ and so on.}$$

Hence, the sutra "Ekadhikena" provides a square of any number ending with 5. The equation (2) is the sutra for better understanding. If we have to square 105,

$$(10Y_2 5)^2 = 10(10+1)Y_3 25 = 10 \times 100 + 25 = 11025$$

b. Operator inverse Y^{-1}:

Reverse process of the operations of the operator Y is known as inverse Y operator and can be presented as

$$Y_m^{-1} = -25 \times 10^{-(m-1)}$$

Therefore $$\mathrm{Y}_3^{-1}\, 1025 = \frac{(1025-25)}{10^{3-1}} = 10$$

3. Square root of a number

The west component, 'b' of a number is obtained using the Y^{-1} operator and the terminal component (T=25) as,

West component of $\mathrm{N} = b = \mathrm{Y}_3^{-1}\,\mathrm{N} = \frac{(\mathrm{N}-25)}{10^{3-1}} = \frac{(\mathrm{N}-25)}{100}$

It's clear from the sutra "Ekadhikena Purvena" that,

$$b = t(t+1) \qquad \text{...(3)}$$

Hence the discriminant component is written as

$$D = \pm\sqrt{4b+1} \qquad \text{...(4)}$$

The root component t of equation (3) is expressed by

$$t = \frac{D-1}{2} \qquad \text{...(5)}$$

Now the square root is given by

$$\sqrt{N} = tY_2\left|\sqrt{T}\right| \qquad \text{...(6)}$$

Comprehensively the formula is

$$\sqrt{N} = \left(\frac{\pm\sqrt{(4Y_3^{-1}N+1)}-1}{2}\right) \times 10 + 5 \qquad \text{...(7)}$$

Examples:

1. $\sqrt{11025}$ (a complete square ending with 25)
   Terminal component T=25
   West component $b = \mathrm{Y}_3^{-1}\, 111025 = \frac{(11025.-25)}{10^{3-1}} = \frac{(11000)}{100}$ =110
   The discriminant, $D = \pm\sqrt{4b+1} = \pm\sqrt{4 \times 110 + 1} = \sqrt{441}$ =21
   The root component, $t = \frac{D-1}{2} = \frac{21-1}{2} = 10$
   The square root of 11025 = $tY_2\left|\sqrt{T}\right|$ =10 Y_2 5 =$10 \times 10^{2-1} + 5 = 105$
   Hence, $\sqrt{11025}$ =105

2. $\sqrt{8836}$ (a complete square not ending with 25)
   Terminal component T=25
   West component, $b = \mathrm{Y}_3^{-1}\ 8836 = \frac{(8836-25)}{10^{3-1}} = \frac{(8811)}{100}$ =88.11
   The discriminant, $D = \pm\sqrt{4b+1} = \pm\sqrt{4 \times 88.11 + 1} = \sqrt{353.44}$ =18.8
   The root component, $t = \frac{D-1}{2} = \frac{18.8-1}{2} = 8.9$
   The square root of 8836 = $tY_2\left|\sqrt{T}\right|$ =8.9 Y_2 5 =8.9 $\times 10^{2-1} + 5 = 94$
   Hence, $\sqrt{8836} = 94$

3. $\sqrt{1238}$ (a number which is not a complete square)
   Terminal component T=25
   West component, $b = \mathrm{Y}_3^{-1}\ 1238 = \frac{(1238-25)}{10^{3-1}} = \frac{(1213)}{100}$ =12.13
   The discriminant, $D = \pm\sqrt{4b+1} = \pm\sqrt{4 \times 12.13 + 1} = \sqrt{49.52}$ =7.0370
   The root component, $t = \frac{D-1}{2} = \frac{7.0370-1}{2} = 3.0185$
   The square root of 1238 = $tY_2\left|\sqrt{T}\right|$ =3.0185 Y_2 5 =3.0185 $\times 10^{2-1} + 5 = 35.185$
   Hence, $\sqrt{1238} = 35.185$

4. $\sqrt{100100025}$ (a large number)
   Terminal component T=25
   West component, $b = \mathrm{Y}_3^{-1}\ 100100025 = \frac{(100100025-25)}{10^{3-1}} = \frac{(100100000)}{100}$ =1001000
   The discriminant, $D = \pm\sqrt{4b+1} = \pm\sqrt{4 \times 1001000 + 1} = \sqrt{4004001}$ =2001
   The root component, $t = \frac{D-1}{2} = \frac{2001-1}{2} = 1000$
   The square root of 100100025 = $tY_2\left|\sqrt{T}\right|$ =1000 Y_2 5 =1000 $\times 10^{2-1} + 5 = 10005$
   Hence, $\sqrt{100100025} = 10005$

Conclusion:

With spiritual enlightenment of saint Shri Bharati Krasna Thirtha Swamiji, whose insight taken shape foundational basis of one of Vedic sutra. Ekadhikena Purvena, has led algebraic formulation and this algorithm that calculates the square root of any given number, positive integer or real number of digit 10. The generalized formulation contains a new operator Y (Yojayet) and its inverse Y^{-1} to make the calculation handy.

Reference:

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