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A Digit Model Algorithm for the Performance of Square of Numbers

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Abstract: This study presents, findings on the manual squaring of numbers be it positive, negative, decimal or fractional. Presented is the model algorithm of squaring where use is made of the digits of the number to be squared. To substantiate the validity of the developed algorithm, examples of the squares of numbers were given for positive and negative numbers of single, double, triple, four digit numbers, decimal numbers and fractions. Results show that any number can be manually and unconventionally squared making use of the digit model algorithm.

Key words: Algorithm, digits, integers, numbers, validation, performance

INTRODUCTION

Number theory, as manifested from civilization to civilization is as old as mankind. Due to the unquestioned historical importance of number theory, it has always occupied a unique position in the world of mathematics, science and engineering (Friberg, 2008).

There is a wealth of literatures reported since, the middle of the last century on the number theory. The importance of the number theory can be gauged not only from the vastness of the literatures that exist on the subject but also from the depth and thoroughness with which, number theory problems have been carried out. Pierre-de Fermat (1601-1665) was the first person who began and considered problems on number theory. Pierre de Fermat, however, gave number theory a starting point by rescuing it from the realm of superstition and occultism, where it had been imprisoned (Burton, 2007). Fermat's influence was limited by the lack of interest in publishing the discoveries, which are known mainly from letters to friends and marginal notes in the books he read. In 1629, Fermat invented analytic geometry, but most of the credit went to Descartes; who hurried into print with his own ideas in 1937. Newton acknowledged, in a letter that became known only in 1934 that some of his own early ideas came directly from Fermat. In a series of letters written in 1654, Fermat and Pascal jointly developed the fundamental concepts of the theory of probability (Adetunde, 2007). Interesting aspects of number theory featured strongly in the Sumero-Babylonian cuneiform mathematical texts, where Sexagesimal multiplication tables were the vogue (Friberg, 2008).

Relevant publications on square of numbers were undertaken such as Adetunde (2007), Akinpelu *et al.* (2005) and Uko (1993, 1996). Several investigators have researched on the theory of numbers notable among them are, Leonhard Euler (1707-1703), Gabriel Lame (1795-1870) and Godfrey Harold Hardy. Srinivara Ramanuyan (1887-1920) and Paul Erdo's (1913-1996) to mention a few.

The real core of this study is therefore, to extend the researches done by Adetunde *et al.* (2005) another dimension of performing squaring of numbers of any form be it positive, negative, decimal or fractional. Arithmetical examples are used for illustrations. Results show that any number can be manually and unconventionally squared making use of the digit model algorithm.

MATERIALS AND METHODS

Algorithm of computations:

Step 1: Rewrite the given number into two separate portions: to the right portion is written the last digit of the given number and to the left portion is written the given number itself.

Step 2: Separately, square the right portion.

Step 3: For the left portion, add the two numbers of the two portions and multiply the result by the number gotten out of the original number written without the last digit; i.e., original number without the right portion digit.

Step 4: Write down the results of computations of the two portions.

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Step 5: For the right portion, drop the units' digit down after, in parenthesis and add the non-units (10s, T; 100s, H; 1000s, TH; etc.) as a number to the result of the left portion.

Step 6: Drop down in parenthesis, the result of the left portion after the addition of the non-units number of the right portion.

Step 7: Collate the in-parenthesis dropped down results of the two portions as the sought for square of the given number.

Demostrative use of the algorithm in terms of alphabets: A demonstrative example is presented for the squaring of the number Z comprising say 3 digits a-c, where, a-c = 0, ……, 9.

Step 1: Z = abc
Z = abc c

Step 2 and 3: $Z^2 = ab\{abc + c\}\ c^2$
$= ab\{Z + c\}\ c^2$

Assume that the square of the right portion i.e., c^2 results in a number comprising two or more digits, thus,

$$c^2 = pqr$$

where:
c, p, q, r = 0, ……, 9

Also, let results of computation of the left portion be represented by U thus,

$$U = ab\{Z + c\}$$

Step 4: $Z^2 = U\ pqr$

We drop down the unit r and add the number pq to the results of computations of the left portion in accordance with step 5:

Step 5: $Z^2 = U + pq\ (r)$

Let, U + pq = V and dropped down, we have,

Step 6: $Z^2 = (V)\ (r)$

Step 7: $Z^2 = (V)\ (r)$

Demostrative use of the algorithm in terms of the numeric numbers: Now, we give the square of 279 as a demonstrative example:

Step 1: Z = 279
Z = 279 9

Steps 2 and 3: $Z^2 = 27\ \{279 + 9\}$ 9^2

Step 4: 7,776 + 8 (1) **(Step 5)**

Step 6: (7,784)

Steps 7: $Z^2 = (279)^2 = 77{,}841$

The algorithm of computations remains functional irrespective of the nature of the number to be squared i.e. positive, negative, decimal or fractional numbers; single, double, triple or four digit numbers. The numerical analysis below confirms this fact.

RESULTS AND DISCUSSION

Numerical investigations are presented in this section to illustrate the aforementioned mathematical algorithms stated in this study. The solutions based on the question solved with the algorithms.

Illustrative examples on square of single digits numbers: positive number, negative number

Example 1: Find the square of 9

Solution

$(09)^2 = 0(09 + 9)$ 9^2

0 8(1)

(8)

=81

Example 2: Find the square of (-8)

Solution

$(-08)^2 = (-0)\ (-08 - 8)$ $(-8)^2$

0 6 (4)

(6)

= 64

Illustrative examples on square of double digits numbers: positive number, negative number

Example 3: Find the square of 17

Solution

$(17)^2 = 1\ (17 + 7)$ 7^2

24 + 4 (9)

(28)

= 289

Example 4: Find the square of 99
Solution

$(99)^2 = 9\,(99 + 9)$ 9^2

927 8 (1)

\+ (980)

= 9801

Example 5: Find the square of (-97)
Solution

$(-97)^2 = (-9)\,(-97 - 7)$ $(-7)^2$

936 4 (9)

\+ (940)

= 9409

Illustrative examples on square of triple digits numbers: positive number, negative number

Example 6: Find the square of 128
Solution

$(128)^2 = 12\,(128 + 8)$ 8^2

1632 6 (4)

\+ (1638)

= 16384

Example 7: Find the square of 879
Solution

$(879)^2 = 87\,(897 + 9)$ $(9)^2$

77256 8 (1)

\+ (77264)

= 772641

Example 8: Find the square of (-573)
Solution

$(-573)^2 = (-57)\,(-573 - 3)$ $(-3)^2$

32832 0 (9)

\+ (32832)

= 328,329

Illustrative examples on square of four digits numbers: positive number, negative number

Example 9: Find the square of 3795
Solution

$(3795)^2 = 379\,(3795 + 5)$ 5^2

1,440,200 2 (5)

\+ (1,440,202)

= 14,402,025

Example 10: Find the square of (-7438)
Solution

$(-7438)^2 = (-743)\,(-7438 - 8)$ $(-8)^2$

5,532,378 6 (4)

\+ (5.532.384)

= 55,323,844

Illustrative examples on square of decimal numbers: positive number, negative number

Example 11: Find the square of 0.7

Note: One decimal place:
Solution

$(0.7)^2 = 0\,(0.7 + 0.7)$ $(0.7)^2$

0 0.4 (9)

\+ (0.4)

= 0.49

Example 12: Find the square of 1.8
Solution

$(1.8)^2 = 1\,(1.8 + 0.8)$ $(0.8)^2$

2.6 0.6 (4)

\+ (2.3)

= 3.24

Example 13: Find the square of 27.3
Solution

$(27.3)^2 = 27\,(27.3 + 0.3)$ $(0.3)^2$

745.2 0.0 (9)

\+ (745.2)

= 745.29

Example 14: Find the square of 357.7
Solution

$(357.7)^2 = 357\,(357.7 + 0.7)$ $(0.7)^2$

127,948.8 0.4 (9)

\+ (127,949.29)

= 127,949.29

Example 15: Find the square of (-0.3)
Solution

$(-0.3)^2 = (-0)\,(-0.3 - 0.3)$ $(-0.3)^2$

0 0.0 (9)

\+ (0.0)

= 0.09

Example 16: Find the square of (-1.9)
Solution

$(-1.9)^2 = (-1)\,(-1.9-0.9) \qquad (-0.9)^2$

$2.8 \qquad 0.8\ (1)$

$+ \quad (3.6)$

$= 3.61$

Example 17: Find the square of (-9.9)
Solution

$(-9.9)^2 = (-9)\,(-9.9-0.9) \qquad (-0.9)^2$

$97.2 \qquad 0.8\ (1)$

$+ \quad (98.0)$

$= 98.01$

Example 18: Find the square of (-23.7)
Solution

$(-23.7)^2 = (-23)\,(23.7 - 0.7) \qquad (-0.7)^2$

$561.2 \qquad 0.4\ (9)$

$+ \quad (561.6)$

$= 561.69$

Example 19: Find the square of 3.97

Note: For two decimal places:
Solution

$(3.97)^2 = (3.9)\,(3.97 + 0.07) \qquad (0.07)^2$

$15.756 \qquad 0.004\ (9)$

$+ \quad (15.760)$

$= 15.7609$

Example 20: Find the square of 83.68
Solution

$(83.68)^2 = (83.6)\,(83.68 + 0.08) \qquad (-0.08)^2$

$7{,}002.336 \qquad 0.006\ (4)$

$+ \quad (7002.342)$

$= 7{,}002.3424$

Example 21: Find the square of (-31.73)
Solution

$(-31.73)^2 = (-31.7)\,(-31.73-0.03) \qquad (0.03)^2$

$1{,}006.792 \qquad 0.000\ (9)$

$+ \quad (1{,}006.792)$

$= 1{,}006.7929$

Example 22: Find the square of 0.739

Note: For three decimal places:
Solution

$(0.739)^2 = (0.73)\,(0.739 + 0.009) \qquad (-0.009)^2$

$0.54604 \qquad 0.00008\ (1)$

$+ \quad (0.54612)$

$= 0.546121$

Example 23: Find the square of 4.784
Solution

$(4.784)^2 = (4.78)\,(4.784 + 0.004) \qquad (0.004)^2$

$22.88664 \qquad 0.00001\ (6)$

$+ \quad (22.88665)$

$= 22.886656$

Example 24: Find the square of (-7.397)
Solution

$(-7.397)^2 = (-7.39)\,(-7.397-0.007) \qquad (0.007)^2$

$54.71556 \qquad 0.00004\ (9)$

$+ \quad (54.71560)$

$= 54.715609$

Example 25: Find the square of 0.3879

Note: For four decimal places:
Solution

$(0.3879)^2 = (0.387)\,(0.3879 + 0.0009) \qquad (0.0009)^2$

$0.150465 \qquad 0.000008\ (1)$

$+ \quad (0.1504664)$

$= 0.15046641$

Example 26: Find the square of (-0.3654)
Solution

$(-0.3654)^2 = (-0.365)\,(-0.3654-0.0004) \qquad (-0.0004)^2$

$0.13351 \qquad 0.0000001\ (6)$

$+ \quad (0.1335171)$

$= 0.13351716$

Evidently from the various examples considered so far, regarding the positive, negative, including the decimal numbers of any form of digit (s), it was observed that the results were accurate and agreed with other methods used in finding the square of numbers. This method has the advantage and merits on the existing methods of square of numbers (Slide Rules and Logarithmic Tables) because given many numerical trials on the examples we still have accurate results.

Remarks: Square of fractions (Both positive and negative numbers): Fractions, positive or negative are squared as either decimal numbers or the squaring is performed separately for the numerator and the denominator.

CONCLUSION

An all-sided squaring of numbers has been presented. It could be deduced that the algorithm presented satisfies the squares of all shades of numbers be it positive, negative (single, double, triple or four digit), decimal or fractional.

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