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New ways of multiplying numbers

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Abstract: *Man has hitherto devised several manual methods to solve the problems of multiplying numbers. The Egyptians and the Russians methods are part of the several ways. In this research some of the old methods of multiplications were analyzed and some new ones were discovered, developed and formulated by the author. This paper presents to the world, new manual ways of multiplying numbers.*

Keywords: *New methods, Old methods, Egyptian method, Russian method, Common method, Multiplication, Manual, Numbers, Whole Numbers, Decimal, Formulae,*

I. Introduction:

From the days of early civilization. Man has been able to use different approaches to multiply numbers. The Egyptians had their own methods of multiplying numbers and so did some other people. In this research, new methods of multiplying numbers were discovered, developed and formulated by the author. The new methods can be used to solve different problems like multiplying any two whole numbers, multiplying two whole numbers between 10 and 19 inclusive, multiplying two numbers with decimal points and conversion of two digit numbers in base 2 to 9 to a number in base 10. Also in this paper, the Egyptian, the peasant and the common methods of multiplying numbers wereanalyzed.

II. New methods discovered by the author:

The new methods discovered by the author have been highlighted in the sub-sections 2.1, 2.2, 2.3 and 2.4below.

2.1 Method for multiplying two numbers with decimal points This method can be seen in the example below by applying the following formulae: Let P and Q represent the 2 numbers to bemultiplied

$P = P_0 + P_i s$

$Q = Q_0 + Q_1$

Where P_0 = the whole number part of P P_1 = Decimal part ofP
Q_o = the whole number part of Q Q_1 = Decimal part ofQ

ALGORITHM

1. Multiply P_1 byQ_1
2. Multiply Q_o by the sum of P andQ_1
3. Multiply Q_1 by the difference of P_0 andQ_0
4. Add 1, 2 and3

$P \times Q = (P_1 \times Q_1) + (P+Q)Q_0 + (P_0 - Q_0)Q_1$

Example:

$5.5 \times 0.4 = (0.5 \times 0.4) + (5.5 + 0.4)\ 0 + (5\text{-}0)0.4$
$= 0.2 + 0 + 2$
$= 2.2$

2.2 Methods for multiplying any two whole numbers Let A And B represent the two whole numbers to be multiplied

This method can be seen in the examples below by applying thefollowing formulae:

Algorithm

1. Multiply $A_i$by B_i
2. Multiply B_o by the sum of A and $B_i$and by10

3. Multiply B_i by the difference of A_O and B_O and by10

4. Add 1, 2 and3

$A \times B = (A_i \times B_i) + (A + B_i)\ 10B_O$
$+ (A_O - B_O)10B_i$

Examples:

(1) $154 \times 11 = (4 \times 1) + (154 + 1)\ 10 \times 1 + (15 - 1)\ 10 \times 1 = 1694$
(2) $79 \times 10 = (9 \times 0) + (79 + 0)\ 10 \times 1 + (7\text{-}1)\ 10 \times 0 = 790$

2.3 Fast method of multiplying two numbers between 10 And19 Inclusive.

This method can be seen in the example below by applying the following formulae:

$A = A_OA_i \neq A_O \times A_iB$
$= B_OB_i \neq B_O \times B_i$
Where, A_i= Last digit of A A_O = Other digit ofA
B_i= Last digit of B B_O= Other digit ofB

ALGORITHM

1. Multiply A_i and B_i

2. Add A and B_i

3. Add 1, 2 in a step like manner Where A and B are the twonumbers

B_i- Second digit of second number Example:

Multiply 19 by16
19

16

54 = 9 x6

+ 25 = 19 +6

304

Example: Multiply 18 by17

18

x17

56 =8x7

+ 25 =18+17

306

2.4 New method of converting two digit numbers In Base 2 To 9 To Base10

This method can be seen in the example below by applying the following formulae:

$$\begin{array}{rl} & A \\ & \underline{xB} \\ & A \times B \\ + & \underline{A + B_i} \\ & \underline{A \times B} \end{array}$$

Algorithm

1. Multiply C by 01 of the samebase.
2. Multiply B by1
3. Multiply n by 0 and by the sum of C and1
4. Multiply n by 1 and by the difference btw A and0
5. Add 1, 2 and3

Where, C = The 2 digitnumber, B = 2nd digit ofC
A = 1st digit ofC

n = Any base between 2 and 9 inclusive.

Example: Convert 456 to base10

$45_6 \times 01_6 = (5x1) + (46+1)\ 6x0 + (4-0) \times 6x1 = 5 + 24 = 29_{10}$

Most of them would normally take a longer time to calculate compared to some of the common methods yet there exists one method amongst them that is faster than its equivalent common method. The fast method can be used to multiplyany 2 whole numbers between 10 and 19 inclusive. Others take longer periods but all show theiruniqueness.
This paper presents different manual methods of multiplyingnumbers.

III. Egyptian method of multiplication:

According to O` Connor J.J and Robertson E.F. (2000), the Egyptian method of multiplication can be used to multiplying number. This is shown in the example:

Multiply 41 by59

41	59	
1	59	..... Level1
2	118	..... Level2
4	236	..... Level3
8	472	..... Level4
16	944	..... Level5
32	1888	..... Level6

$41 \times 59 = 59 + 472 + 1888 = 2419$

Algorithm

1. Draw a table as shownbelow.
2. Write 41 on the left side and 59 on the rightside.
3. Write 1 under41.
4. Write 59 under59.
5. Double the numbers on both sides as the levelsincrease.
6. Stop on reaching the level that has 32 on the left hand side. Note: 64 is not written since 64 >41.
7. Subtract 32 from41
8. Subtract 8 from answer of step7
9. Subtract 1 from answer of step8
10. Add up the numbers of the right side of levels 1, 4 and 6 of thetable.

Mathematical representations of steps 8-10 41 - 32 = 9, 9 - 8 = 1, 1- 1 =0

Adding up the different values on the other side at 1, 8 and 32, we have 41 x 59 = 59 + 472 + 1888 =2419

IV. Russian peasant multiplication

According to Tapson (2004), the Russian Peasant multiplication can bedone using the procedure below. This can be seen below in multiplying 27 by56:

27 X 56	
54	28
108	14
216	7
432	3
864	1

27 x 56 = 216 + 432 + 864 =1512

Algorithm:

1. Start
2. Draw the table
3. Write the two numbers
4. Halve the bigger no until it becomes1
5. Double the second number
6. .Add up the last three values of the multiple of the firstnumber
7. Stop

V. Common methods:

According to David – Osugwu (1979), one can use a common manualmethod to multiply any two numbers, making use of a table containing Thousands, Hundred, Tens and Units. This can be shown below in the examples below; multiplying 68 by 3, multiplying 32 by 27 and also by 256 by134

Example1:

Th	H	T	U
		6	8
x		0	3
		2	4
+	1	8	0
	2	0	4

Algorithm1:

1. Multiply the last digits of the twonumbers.
2. Multiply the other digit(s) of the 1st number by last digit of the 2nd number and a constant of10.
3. Add steps 1 and2.

Example2:

32
x 27
32 x27
+ (32 x 2)10
224
+640
864

Algorithm 2

1. Multiply 1st number by last digit of 2ndno.
2. Multiply 1st number by other digit of the 2nd no and a constant of10
3. Add steps 1 and2.

Example3:

256 x 134

256 x100

256 x30

256 x4

256 (100 + 30 + 4) = 256 x 134 = 34,304

Algorithm 3

1. Multiply 1st number by 1st digit of 2nd no and100.
2. Multiply 1st number by 2nd digit of 2nd and by10.
3. Multiply 1st number by the last digit of 2ndnumber
4. Add up steps 1, 2 and3

5.1 Common method for converting two digit numbers in Base (2 To 9) To Base10

According to Macrae et al (2000), there is a common method for converting two digit numbers in other bases to base 10. This can be seen in the two examples below using the following formulae.

$C_n = (A \times n1) + (B \times n0)$

$= (An + B)10$

Where C = Number to beconverted

n = Any number base between 2 and9 A = First digit of thenumber
B = Second digit of thenumber

Algorithm

1. Multiply A and n raised to the power of1
2. Multiply B and n raised to the power of0
3. Add 1 and2

Example 1. Convert 456 to base 10456
$= (4 \times 61) (5 \times 60) = 24 + 5 = 2910$

Example 2. Convert 10012 to baseten
$10012 = (1x23) + (0 \times 22) + (0x21) + (1x20) = 910$

VI. Conclusion:

The new ways of multiplying numbers discovered by the author have been found to be effective in solving problems manually and are therefore recommended for use.

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