

Matrix Representation of Multiplication

Atul N. Desai, Tejpal H. Goda

Abstract:- Multiplication is the basic process of mathematical operations. In the vedic mathematics for this lengthy process, a simple process is used with the help of urdhva tiryakbhyam sutra. It helps to avoid small work in calculator which can be manually done easily. If a person starts using this method without sufficient practice, many a times one can make mistakes in long calculations during cross and vertical multiplication and addition at a time. To avoid these mistakes a simple matrix form representation of the multiplication can help this technique without long calculation of multiplication and addition at a time.

Keywords- Matrix, Multiplication

I. INTRODUCTION

Suppose we have to multiply $(Ax + B)$ with $(Cx + D)$, the product is $acx^2 + x(ad+bc) + bd$. In other words, the first term, i.e. the coefficient of x^2 is got by vertical multiplication of a and c ; the middle term, i.e. the coefficient of x is obtained by the cross-wise multiplication of a and d and of b and c and addition of the two products; and the independent term is arrived at by vertical multiplication of the absolute terms. And, as all arithmetical numbers too. Now, if our multiplicand and multiplier be of 3 digits each, it merely means that we are multiplying thus pattern of multiplication observed is:

$$(ax^2+bx+c) \text{ by } (dx^2+ex+f) \text{ (where } x= 10\text{):}$$

$$ax^2+bx+c$$

$$dx^2+ex+fadx^4 +x^3(ae+bd) +x^2(af+be+cd) + x(bf+ce) +cf$$

<p>Step 1 2 5 2 result = 12 8 4 6 pre carry = 0 ----- 2 12</p>	<p>Step 2 2 5 2 result = 38 X 8 4 6 pre carry = 1 ----- 92 39</p>
<p>Step 3 2 5 2 result = 48 X 8 4 6 pre carry = 3 ----- 192 51</p>	<p>Step 4 2 5 2 result = 48 X 8 4 6 pre carry = 5 ----- 3192 53</p>
<p>Step 1 2 5 2 result = 16 8 4 6 pre carry = 5 ----- 213192 21</p>	

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II. MATRIX REPRESENTATION OF THE SAME CAN BE DONE AS UNDER

The matrix is represented by various numbers as A_{11} , A_{12} , A_{13} , A_{21} , A_{22} , A_{23} etc.

Here attempt is made to represent multiplication in the matrix form. A_{11} means multiplication of first digit of the multiplicand and multiplier and so on. Hence the entire multiplication can be represented as under.

	8	4	6
2	16	8	12
5	40	20	30
2	16	8	12

Finally adding the results of multiplied numbers and arranging them in proper format the result can be obtained as under.

	16	40 + 8 = 48	12 + 20 + 16 = 48	30 + 8 = 38	12
1	6	8	8	8	2
(+1)	4	4	3	1	
2	1	3	1	9	2

Example 1:

Vedic Method:

2583*41

<p>Step 1 2 5 8 3 result = 3 4 1 pre carry = 0 ----- 3 3</p>	<p>Step 2 2 5 8 3 result = 20 X 4 1 pre carry = 0 ----- 03 2</p>
<p>Step 3 2 5 8 3 result = 37 X 4 1 pre carry = 2 ----- 903 39</p>	<p>Step 4 2 5 8 3 result = 22 X 4 1 pre carry = 3 ----- 5903 25</p>
<p>Step 1 2 5 8 3 result = 8 4 1 pre carry = 2 ----- 105903 10</p>	

	2583	
	X 41	
	4	1
2	2*4=8	2*1=2
5	5*4=20	5*1=5
8	8*4=32	8*1=8
3	3*4=12	3*1=3

Alternate Matrix representation

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Matrix Representation of Multiplication

	2
8	/
20	/ 5
32	/ 8
12	/ 3

Summing all intermediate answers to get final answer, such that **first digit of number goes down to previous on**

	8	20+2=22	32+5=37	12+8=20	3
	8	2	7	0	3
(+1)	2	3	2		
1	0	5	9	0	3

OR

	2	5	8	3
4	8	20	32	12
1	2	5	8	3

8	20+2= 22	32+5=37	12+8=20	3
			0	
8	2	7	0	3
2	3	2		
10	5	9	0	3

Example 2:

Vedic Method:

987*123

Step 1 $\begin{array}{r} 9\ 8\ 7 \\ \times 1\ 2\ 3 \\ \hline 27 \\ 180 \\ 900 \\ \hline 2943 \end{array}$ result = 21 pre carry = 0	Step 2 $\begin{array}{r} 9\ 8\ 7 \\ \times 1\ 2\ 3 \\ \hline 27 \\ 180 \\ 900 \\ \hline 2943 \end{array}$ result = 38 pre carry = 2
Step 3 $\begin{array}{r} 9\ 8\ 7 \\ \times 1\ 2\ 3 \\ \hline 27 \\ 180 \\ 900 \\ \hline 2943 \end{array}$ result = 50 pre carry = 4	Step 4 $\begin{array}{r} 9\ 8\ 7 \\ \times 1\ 2\ 3 \\ \hline 27 \\ 180 \\ 900 \\ \hline 2943 \end{array}$ result = 26 pre carry = 5
Step 1 $\begin{array}{r} 9\ 8\ 7 \\ \times 1\ 2\ 3 \\ \hline 27 \\ 180 \\ 900 \\ \hline 2943 \end{array}$ result = 9 pre carry = 3	
$\begin{array}{r} 121401 \\ \times 12 \\ \hline 242802 \\ 121401 \\ \hline 1456812 \end{array}$	

Alternate Matrix representation

	9	8	7
1	9	8	7
2	18	16	14
3	27	24	21

	9	18+8 =26	27+16+7= 50	14+24= 38	21
	9	6	0	8	1
(+1)	2(+1)	5	3(+1)	2	
1	2	1	4	0	1

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