AN INNOVATIVE METHOD OF MULTIPLICATION
(Advancement of Ekadhiken Purvena Sutra)

S.G.Chitnis

Abstract

The general method for multiplication in vedic mathematics is the Urdhwa Tiryagbham Sutra (Vertically and crosswise). A special method for multiplication is the Nikhilam Navatasharamam Dasatha Sutra (All from 9 and the last from 10), which deals with bases and sub-bases of numbers. A corollary of the Nikhilam method, Ekadhikena Purvena (By one more than the one before) and a sub-corollary, Antyayordasakepi (When the final digits total 10) provide a further special method. These two corollaries can used when the two numbers have the same tens digit and complementary ones digits, for example 62×68 or 54×56.

The aim of this article is to show how the methodology of these special sutras can be transformed into a general method, thus making special methods part of modern mathematics teaching without any specific condition, such as 69×34, 436×225, etc. This innovative method of multiplication will help mathematics learners think differently and help them to explore and expand the range of applications.

Introduction

Modern mathematics teaching mainly relies on general methods that safely handle the whole class of problems, but does not make mathematics a creative subject for students. On the other hand special methods are the characteristics of Vedic mathematics that can be used as per requirement of problems. However, there is a scope for generalization of the Ekadhikena Purvena method so that it can be applied without any pre-requisite condition.

Proposed Methodology

The proposed methodology will contain the following steps for multiplying two numbers:

1. Put the bigger number as multiplicand and smaller one as multiplier to minimise the bar digit.
2. Find the product of Ekadhikena purvena (adding 1) of tenth place of the multiplicand and the tenth place number of multiplier.
3. Find the difference of tenth place of both numbers and multiply it by unit place number of multiplier.
4. Find the sum of unit place digit of both numbers and subtract 10 from the sum.   Multiply this number with tenth place number of multiplier. Add the product to step 3 number.
5. Multiply the digits of unit place of both the numbers.
6. The solution is then place value addition of three numbers resulting from Step 2, Step 3-4 and Step 5.

Algebraic Proof

Let the two numbers be ab and cd with *base 10*

ab*cd = (10a+b) * (10c+d)

= 100ac + 10(ad + bc) + bd

Adding and subtracting 100c and 10cd to this equation,

= 100ac + 10(ad + bc) + 100c - 100c +10cd − 10cd + bd

= 100ac + 100c +10(ad − cd + bc + cd -10c) + bd

=100 (ac+c) + 10 ((a-c)*d + (b+d-10)*c) + bd

Considering the place value of the digits,

= (a+1)*c | (a-c)*d + (b+d-10)*c | bd

This formula gets modified as the base changes, for example
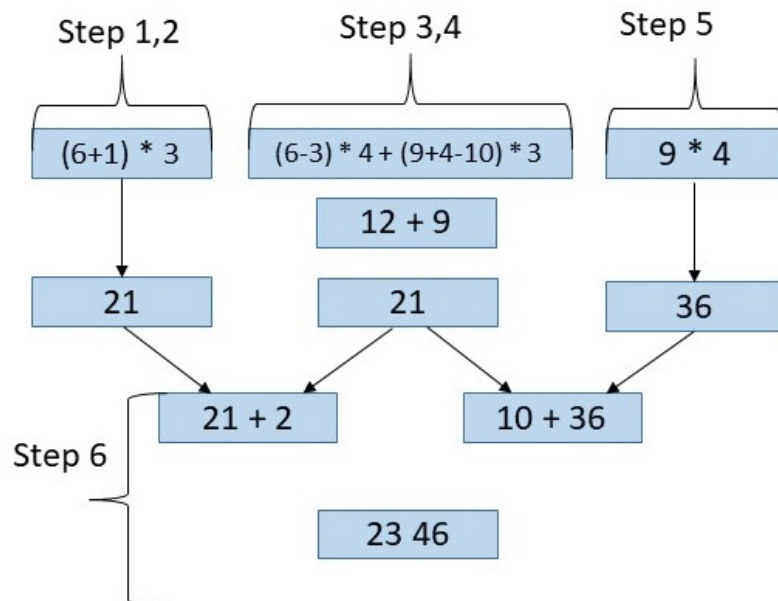
For base 100, (a+1)*c | (a-c)*d + (b+d-100)*c + bd

For base 1000, (a+1)*c | (a-c)*d + (b+d-1000)*c + bd

Thus the above formula can be used to multiply two numbers having different bases. It also can be used to find square of a number. The scope of this formula is very wide. It increases the flexibility in choosing the base and also the creativity of Vedic mathematics learner.
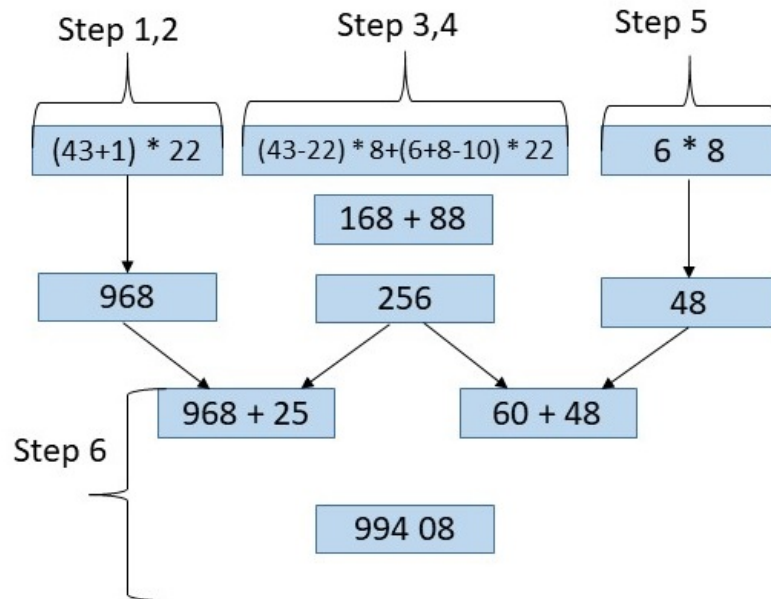
Case Studies

Case 1 When sum of unit place digits is greater than 10
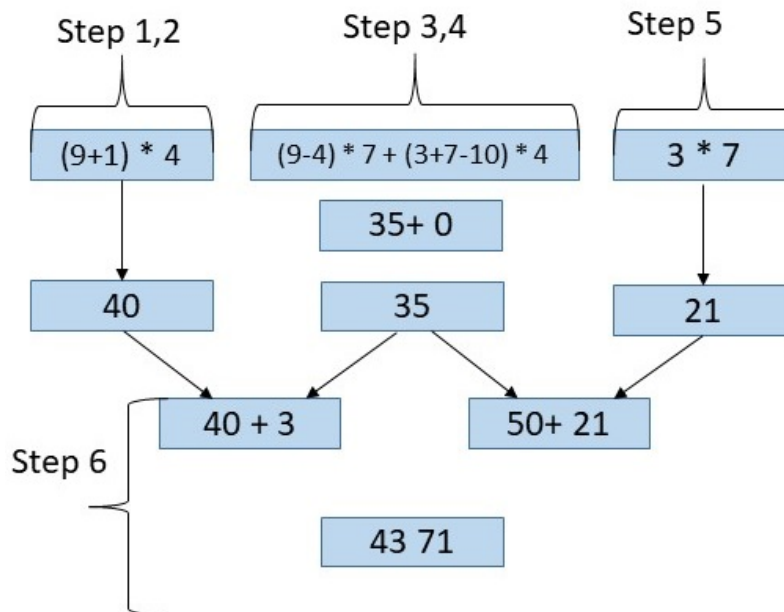
Example 1 69 * 34

Example 2 436 x 228

Step 1,2	Step 3,4	Step 5
(43+1) * 22	(43-22) * 8+(6+8-10) * 22	6 * 8

168 + 88

968   256   48

968 + 25   60 + 48

Step 6

994 08

Case 2 When sum of unit place digits is equal to 10.

Example 3 93 x 47

Step 1,2	Step 3,4	Step 5
(9+1) * 4	(9-4) * 7 + (3+7-10) * 4	3 * 7

35+ 0

40   35   21

40 + 3   50+ 21

Step 6

43 71

Example 4 946 * 344

Step 1,2   Step 3,4   Step 5

| (94+1) * 34 | (94-34) * 4 + (6+4-10) * 34 | 6 * 4 |

240 + 0

| 3230 | 240 | 24 |

3230 + 24   0 + 24

Step 6

325 424
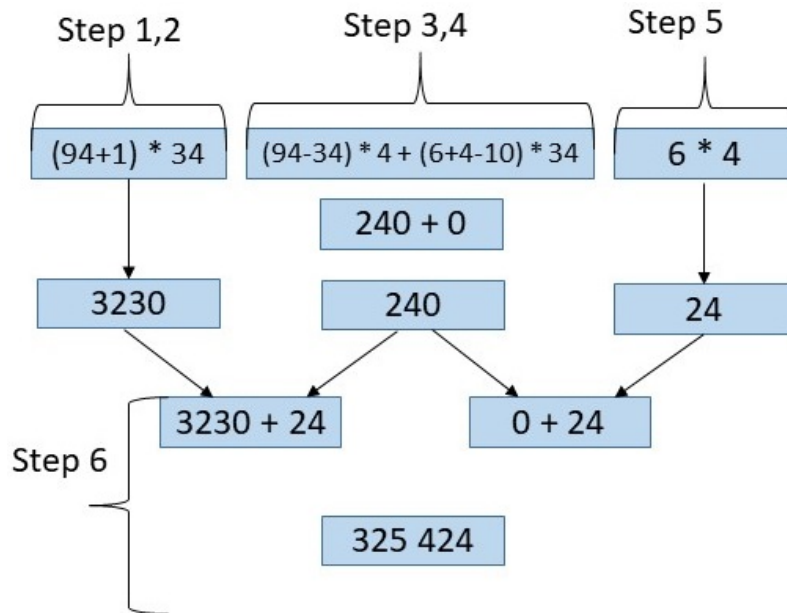
Case 3 When the sum of unit place digits is less than 10.

Example 5 63 * 45

Step 1,2   Step 3,4   Step 5

| (6+1) * 4 | (6-4) * 5 + (3+5-10) * 4 | 3 * 5 |

$10 + \overline{8}$

| 28 | 02 | 15 |

28 + 0   20 + 15

Step 6

28 35

Example 7 642 x 354

Step 1,2

Step 3,4

Step 5

| (64+1) * 35 | (64-35) * 4 + (2+4-10) * 35 | 2 * 4 |

$$116 + \overline{140}$$

| 2275 | $\overline{24}$ | 08 |

$$2275 + \overline{2}$$

$$\overline{40} + 08$$

Step 6

$$2273\ \overline{32}$$

$$227268$$
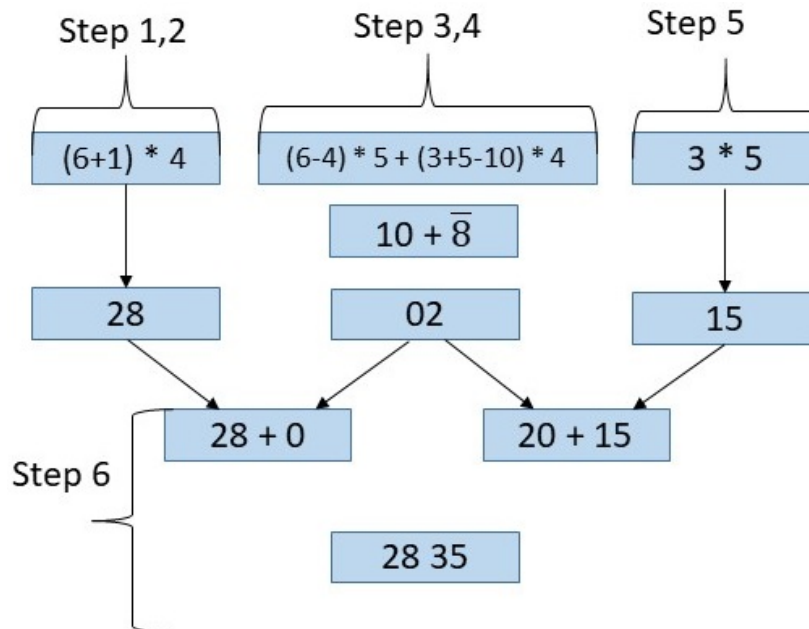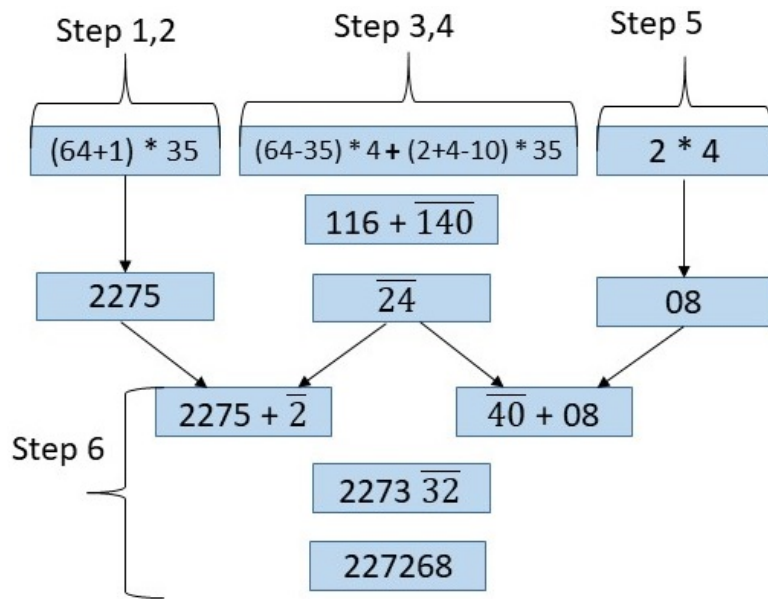
Case 4 When the base is 100.

Example 8 4321 * 1234

Step 1,2

Step 3,4

Step 5

| (43+1) * 12 | (43-12)*34 + (21+34-100)*12 | 21 *3 4 |

$$1054 + \overline{540}$$

| 528 | 514 | 714 |

$$528 + 5$$

$$1400 + 714$$

Step 6

$$533\ |\ 2114$$

$$5332114$$
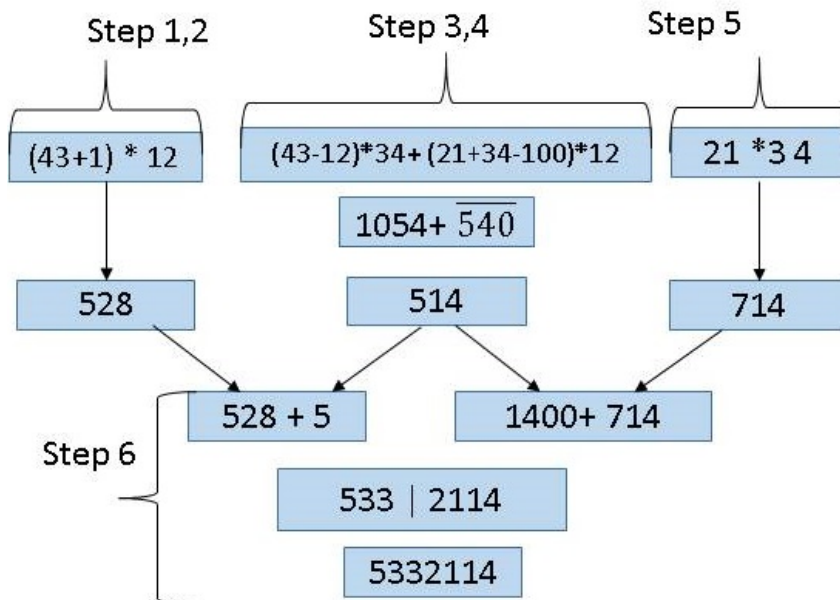
Case 5 When base is 1000.

Example 9 4321*1234

Step 1,2   Step 3,4   Step 5

(4+1) * 1   (4-1)*234 + (321+234-1000)*1   321 *23 4

702 + $\overline{445}$

5   257   75114

500 + 25   7000+ 75114

Step 6

525 + 8 | 2114

5332114
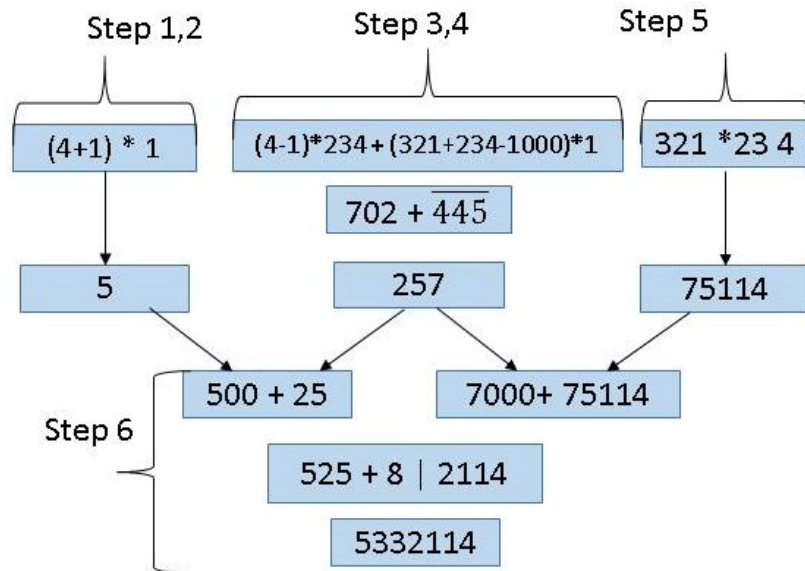
Case 6 When number is multiplied by itself.

Example 10 116 * 116

Step 1,2   Step 3,4   Step 5

(1+1) * 1   (1-1)*6 + (16+16-100)*1   16 *16

0+ $\overline{68}$

2    $\overline{68}$ 256

200 + $\overline{60}$ $\overline{800}$+ 256

Step 6

14000 + $\overline{544}$

13456
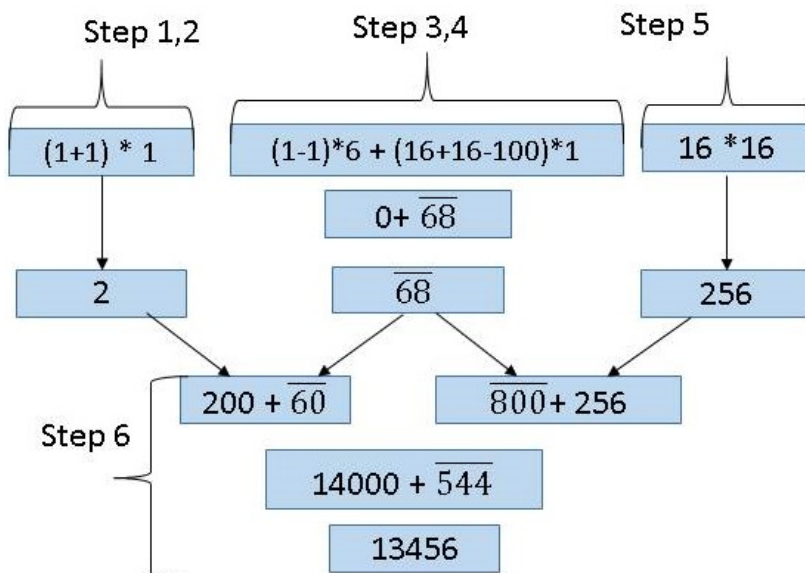
Conclusion

We have seen that how we can use the methodology of the Ekadhiken Purvena Sutra for multiplication of two and three digit numbers. In comparison to general methods of multiplication like vertically and crosswise or making a common base of different base

numbers, the above algorithm is simple and flexible. The solutions in the examples above are obtained at base 10, but they can be solved at the base 100 and 1000 as well.

Thus we can say that we have been able to transform the most valuable special method Ekadhikena Purvena into a general method for multiplication.

Future Work

I am currently working to extend the above algorithm for multiplication three numbers (X*Y*Z) in abovementioned cases and also applying the Nikhilm sutra for multiplying numbers with multiple digits having the same left-hand digit(s).

Reference

"Vedic Mathematics" Swami Bharati Krsna Tirthaji Maharaj, Motilal Banarasidas Publishers, Delhi.