IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 1, April 2022
Impact Factor: 6.252

# Review on Vedic Mathematics

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**Abstract:** *Vedic mathematics is claimed by its founder to be a present given to the current by the traditional sages of Asian countries, although there is no historical evidence that for this claim. It is a system for limited computation and polynomial calculation which his easier and more convenient than the corresponding algorithm in present math. Vedic Mathematics is the ancient technique used to mentally solve add, subtract, and multiply. In this era of digitization, engineers are working to enlarge digital circuits' speed while reducing the size and energy consumed. Arithmetic operations are the basic units of all the digital circuitry and hence rewriting these units increases the efficiency of the entire digital design. By using this technique answer any question in one line. Vedic Mathematics doesn't get its due importance; it is a fantastic method. Vedic Mathematics is a great technique to master calculations, being more adequate and authentic. In this survey paper, we will come up with reader. An overview of Vedic mathematics, as well as some progressive works in space.*

**Keywords:** Vedic Mathematics, Sutras, Nikhilam sutra, RSA algorithm, Urdhva-tiryagbhyam, Vedic multiplier.

## I. INTRODUCTION

Vedic Maths arrives from the Vedas, more specifically the Atharva Veda. It was boosted by Indian mathematician called Jagadguru Shri Bharati Krishna Tirthaji in between 1911 and 1918. Vedic mathematics is contingent on 16 sutras and 13 sub sutras. He formerly executed this work in a book called Vedic mathematics at the time 1965.These conventions are very general and can be applied in many ways. The magic of Vedic Maths lies in the fact that it decreases otherwise bulky-looking calculations in conventional mathematics to very simple ones. This is so because the Vedic formulae are claimed to be dependent on the natural conventions on which the human mind labors. It is a curious field that presents some effective algorithms which can be used in various branches of engineering such as computing, digital signal processing, and VLSI implementation.

This paper is geared up in the following sections: Section II affords an overview of the Vedic sutras, part III elaborates on the makes use of these sutras, and the overall performance of Vedic algorithms is analyzed in part IV and the ultimate part concludes the paper.

## II. VEDIC MATHEMATICS SUTRAS

The whole operations of Vedic mathematics contain 16 sutras-formulae and 13 sub sutras:

### 2.1 Sutras

- Ekadhikena Purvena
- Nikhilam Navatascharamam Dashatah
- Urdhva-tiryagbhyam
- Paravartya Yojayet
- Shunyam Samyasamucchaye
- Anurupye Sunyamanyath
- Sankalana Vyavakalanabhyam
- Puranapranabhyam

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- Calana-Kalanabhyam
- Yavadunam
- Vyastisamashtih
- Sheshanynkena Charmena ch Yojayet
- Sopantyadvayamantyam
- Ekanyunena Purvena
- Ginitasamucchayah
- Gunaksamucchayah

**2.2 Sub-Sutras**

- Anurupyena
- Shishyate Sheshsamjnah
- Adyamadye Nantyamantyena
- Kevalaih Saptakam Gunyat
- Vestanam
- Yavadunam Tavadunam
- Yavadunam Tavadunikutya Varganka
- Antyayordhshakepi
- Antyatoreva
- Samucchayagunitah
- Lopanasthapanabhyam
- Vilokanam
- Gunitasamucchyah samucchayagunitah

In our Engineering field most of the researchers are adopting the following sutras, we will describe them briefly:

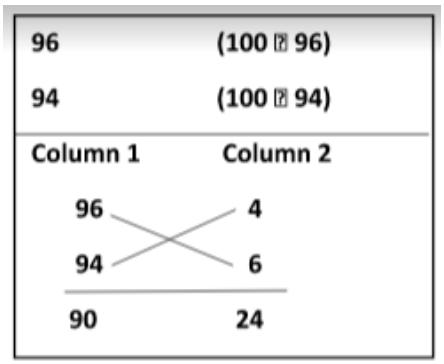
**2.3 Nikhilam Sutra**

This is a approach used to multiply numbers that are closer to the power of 10.Nikhilam Navatascharam Dashatah which means "All from 9 and Last from 10".Mainly this sutra is used to convert a large-digit multiplication to small digit multiplication with the help of subtract, add and shift operations.

Steps for Nikhilam sutra (Number less than nearest base)

| | |
|---|---|
| **Step 1:** | **x × y** |
| **Step 2:** | **X= (Near Base) – x** |
| **Step 3:** | **Y= (Near Base) – y** |
| **Step 4:** | **Z = X × Y** |
| **Step 5:** | **P = x – Y = y – X** |
| **Step 6:** | **Result = 100 × P + Z** |

**For Example:**



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Here is an example of a 2 digit number greater than the nearest radix using the Nikhilam algorithm. We will multiply 104×106 using Nikhilam algorithm.

| | |
|---|---|
| **Step 1:** | **x×y** |
| **Step 2:** | **X=x – (Near Base)** |
| **Step 3:** | **Y=y – (Near Base)** |
| **Step 4:** | **Z = X × Y** |
| **Step 5:** | **P = x +Y = y+ X** |
| **Step 6:** | **Result = 100 × P + Z** |

**For example**:

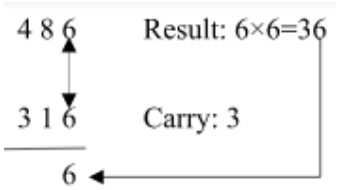
| | |
|---|---|
| **Step 1:** | **104 ×106** |
| **Step 2:** | **X=104 – 100 = 4** |
| **Step 3:** | **Y=106 – 100 = 6** |
| **Step 4:** | **Z = 4 × 6 = 24** |
| **Step 5:** | **P = 104+6 = 106+ 4 =110** |
| **Step 6:** | **Result = 100× 110 + 24=11024** |

Steps for multiplying 2-digit number with modified base

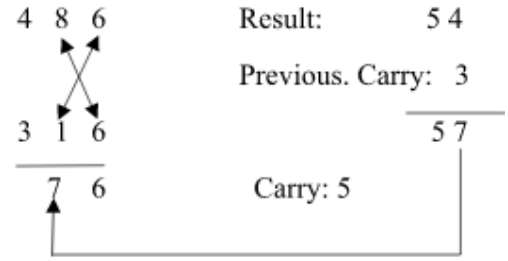
### 2.4 Urdhva-tiryagbhyam

Urdhva-tiryagbhyam sutra literally means a general multiplication type applicable to all multiplication that letters "vertical and horizontal". For example, this sutra is a multiplication of 486× 316 = 153576 by raising parallel processing with partial product generation and sum of them, as shown in Figure.1

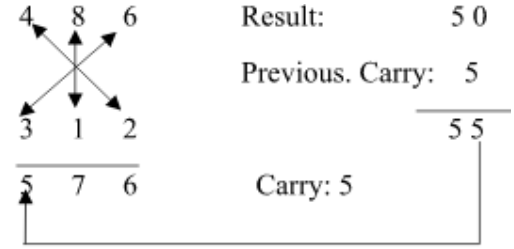
**Step 1:**




**Step 2:**




**Step 3:**



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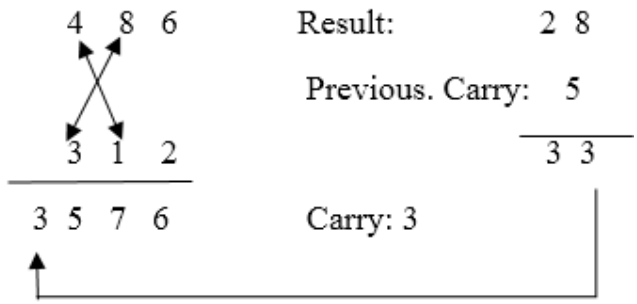
**Step 4:**




**Step 5:**

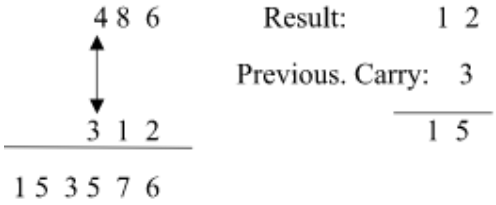



**Figure 1:** Illustration of vertically and crosswise multiplication

Figure 3 shows another calculation method using UrdhvaTriyagbhyamSutra. Consider the multiplication of (4536 x 3124). The number to multiply is written on two consecutive sides of the square, as shown in Figure 1. The square is divided into rows and columns, where each row/column corresponds to one of the multipliers or multiplicand digits. Therefore, each digit of the multiplier has a small box in common with the digits of the multiplicand. These little boxes are split in half by a crosshair. Then each digit of the multiplier is multiplied individually by each digit of the multiplicand and the product of the two digits is written to the common box. All numbers on the cross dot line will be added to the previous carry. The least significant digit of the resulting number acts as the result digit, and the remainder acts as a carry to the next step. The carry of the first step (that is, the dotted line on the far right) is considered nil.

## III. Applied Areas of Vedic Sutras

Many researchers use Vedic Mathematics in the fields of chip design, digital signal processing, discrete Fourier transform, high-speed, low-power VLSI arithmetic and algorithms, and systems, Encryption system, RSA encryption. Most scholars have used Vedic mathematical methods like multiplication, division, squares and cubes in the above-mentioned fields.

### 3.1 Multiplier and Squarer Architecture

Mathematical operations, specially multiplication, drain most of the processing time on the computer. High-speed multiplications are desired in real-time actions and image processing applications. Different multiplier architectonics carry done flourished using distinct algorithms such as array multiplier, booth and Wallace tree. All the preceding algorithms use the necessary conventional method of multiplication.

An exponential table of two binary numbers can be achieved with a micro-operation of using combinational circuits to form products bit all at once, making it a quick way to multiply two numbers because the only delay is the time that the signal travels through the port make a multiplication table. However, a table multiplier requires a large gate step and for this reason, it is less economical.

Squarer is designed using the “Duplex” D property of the binary numbers and the Urdhva-tiryagbhyam sutra, is the smallest and fastest as compared to the conventional multipliers [1].

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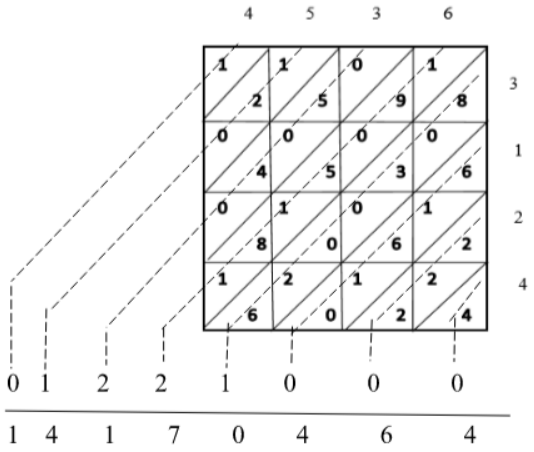


4536×3124 = 14170464

**Figure 3:** Alternative way of multiplication by Urdhva-tiryagbhyam sutra

### 3.2 Discrete Fourier Transform

We can find many algorithms to find the DFT. But today, the only VON-NEUMAN architecture implementation of the Doric approach is used in digital computers. Kulkarni evaluates and compares algorithms performing discrete Fourier transform using enduring and Vedic mathematical techniques [2]. He suggests that architectural-level changes in the entire calculation system to accommodate the Vedic mathematical approach increase the overall competency of the DFT process.

### 3.3 RSA Encryption

In this case, the hardware implementation of the RSA encryption/decryption algorithm employing the algorithms of Ancient Indian Vedic Math has been customized to improve performance[3].

RSA is one of the most secure public key-based standard algorithms for network security. Although the hardware implementation of this algorithm tends to be faster than its software counterpart, there is still the potential for further improvement in RSA hardware performance. One of the most time consuming processes in the RSA encryption/decryption algorithm is computing ab mod n where a is the text, (b, n) is the key [4].

### 3.4 ALU Design

The Arithmetic and Logic Unit (ALU) is the main part of the central processing unit that performs various arithmetic and logical operations. The speed of the arithmetic unit is extremely important and depends a lot on the speed of the exponent. Therefore, technologies are always looking for new algorithms and materials to perform this operation optimally in terms of area and speed. Vedic mathematics refers to different branches of mathematics like arithmetic, algebra, geometry, etc. consumption etc..

Use of Vedic mathematics for multiplication drives a disparity in actual process and hence reduces size and power.The benefits of the Vedic multiplier are increased speed, reduced latency, reduced power consumption, and reduced footprint. It is said that this Vedic coprocessor is more efficient than a regular processor.

### 3.5 Vedic Algorithm Performance Analysis

Many dimensions are suggested by researchers to checkout the working adequacy of Vedic Maths algorithm. The dimensions which are proposed by researchers: time, delay, power and number of slices. Compare the hysteresis factor of (ns) for multiplication performed in different algorithms between the conventional way and the Vedic way.

## IV. CONCLUSION

From the above discussion of Vedic mathematics sutras, for multiplication Urdhva-triyagbhyam sutra is best in case of speed, area and power consumption when compared to the Nikhilam Navatascharamam sutra and other sutras which are

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applicable for multiplication. Nikhilam navatasaraman sutra is also best but it is having certain conditions for multiplication. It is the biggest drawback in this sutra. Vedic mathematical formulas can be used in various algorithms in different computer applications. Different frameworks are calculated to compares different algorithms. It is concludes that computing architectures designed with protected mathematics are proven to improve conventional architecture on calculation speed, electricity use and silicon regions. Other improvements can be done by reducing the abeyancy due to the spread of the product created by intermediate products among multipliers.

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