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Original Article

Ancient Wisdom vs Modern Techniques: A Comparative Analysis of Vedic and Contemporary Mathematics

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Abstract - *The literature of mathematical sciences has been integral to human life since time immemorial. Mathematics, the science of numbers, is foundational to systematic living, underscoring the necessity for a basic understanding among all individuals. In contemporary times, computational tools such as computers and calculators are commonly employed for complex calculations. However, Vedic mathematics, derived from the extensive work of Swami Bharati Krishna Tirthaji Maharaj, offers solutions to all mathematical problems through 16 sutras and 13 sub-sutras. These techniques significantly reduce the time required for problem-solving and can alleviate the fear often associated with mathematics, also known as "Manas Math."*

Keywords - *Enumerator, Mental-math, Ekadhiken purvena, Ekneunen purvena, Urdhvatiragbhayam.*

1. Introduction

Mathematics, science, and literature have been integral components of human civilization since ancient times. Mathematics, in particular, is the science of concepts related to numbers, and its systematic application is indispensable in our daily lives. A fundamental understanding of mathematics is essential for everyone. In contemporary society, the use of computers and calculators to perform complex mathematical calculations has become commonplace. However, Vedic Mathematics, as developed by Swami Bharati Krishna Tirthaji Maharaj, offers an alternative and efficient method for solving mathematical problems. This ancient system encompasses 16 sutras (aphorisms) and 13 sub-sutras (corollaries) that provide solutions to a wide range of mathematical challenges. The application of Vedic Mathematics significantly reduces the time required to solve problems, helping to alleviate the common fear of mathematics. It can be regarded as "Manas Math," emphasizing its mental and intuitive approach to mathematical problem-solving.

2. Comparison of Vedic Mathematics and Modern Mathematics

2.1. Vedic Method and Arithmetic Multiplication by Modern Method

2.1.1. Multiplication by Nikhilam Method

This method utilizes the formula "Nikhilam Navatash Charamam Dashata," which involves subtracting the last digit from 10 and all other digits from 9.

Example: Find 546897 × 999999.

Solution: Using the Ekneunen Purvena formula, reduce one from 546897 to get the left part of the answer. For the right part, subtract 7 from 10 and all other digits from 9 to obtain the answer 5468964553103.

2.1.2. Multiplication by Modern Method

The modern method involves repetitive multiplication steps.

Example: Find 546897 × 999999.

Solution: The process involves multiple steps of multiplication, resulting in the answer 546896453103.

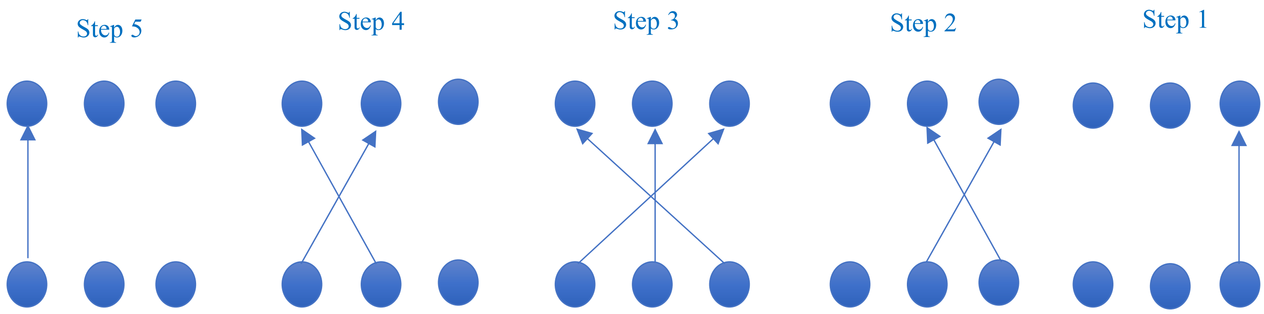
```
      546897
    × 999999
     4922073(546897×9)
    4922073× (shifted one position to the left)
   4922073×× (shifted two positions to the left)
  4922073××× (shifted three positions to the left)
 4922073×××× (shifted four positions to the left)
4922073××××× (shifted five positions to the left)
546896453103
```

2.2. Algebraic Multiplication by Vedic Method and Modern Method

2.2.1. Multiplication by Urdhvatiryagbhayam Method

This formula, meaning vertical and crosswise, simplifies the process.

Example: $(3x^2 + 5x + 2) \times (5x^2 + 3x + 5)$.



Solution: Method to solve this formula

The result is $15x^4+34x^3+40x^2+31x+10$.

2.2.2. Multiplication by Modern Method

Involves step-by-step expansion and simplification.

Example: $(3x^2 + 5x + 2) \times (5x^2 + 3x + 5)$.

Solution: $3x^2(5x^2+3x+5) +5x\,(5x^2+3x+5) +2(5x^2+3x+5)$

$= (3x^2\times 5x^2) +(3x^2\times 3x) +(3x^2\times 5) +(5x\times 5x^2) + (5x\times 3x) +(5x\times 5) +(2 \times 5x^2) +(2 \times 3x) +(2 \times 5)$

$= 15x^4 + 9x^3 + 15x^2 + 25x^3 + 15x^2 + 25x + 10x^2 + 6x + 10$

So, the result is $15x^4+34x^3+40x^2+31x+10$.

2.3. Vedic Method and Arithmetic Division by Modern Method

2.3.1. Division by Dhwajank Method in Vedic Mathematics

The Dhwajank method of division in Vedic mathematics is based on the principle of “Urdhwatiryagbhayam.” The term “Dhwajank” refers to a flag-like number placed above the divisor. This method streamlines the division process using the ancient Vedic mathematical principles, making calculations quicker and more efficient. Here is a step-by-step explanation of the method:

Preparation of the Divisor

- Divide the divisor into two parts.
- The right part, known as the flag (Dhwajank), is written above and slightly to the left of the divisor.
- The left part is written directly below the flag.

Setting Up the Division

- Draw a vertical line to the right equal to the number of digits in the flag.
- This line separates the remainder segment on the right.

Initial Division

- Divide the left part of the dividend by the left part of the divisor.
- Write the quotient above the dividend.
- Write the remainder slightly before the next digit of the dividend below the line.

Subsequent Calculations

- Use the obtained quotient and multiply it by the flag (Dhwajank) using the Urdhvatiryagbhayam principle (from left to right).
- Subtract this product from the new dividend segment to get the modified factor.
- Write this new factor in the same way as before the first digit.

Repeating the Process

- Repeat the division operation with the new quotient and flag number.
- Continue the process of dividing, multiplying, and finding the new dividend until the final modified remainder is obtained.

Completion

- The process is repeated until all digits of the dividend have been processed.
- The final quotient and remainder are obtained as the result of the division.

Example: 32226÷213

Divisor Clause	Composite Clause	Remainder Clause
(flag) 1 3 (modified denominator) 2	3 12 12 1 3 5	22 6 15 1 3
Modified Quotient	3 11 4	6 3
	1 5 1	

Solution:

So, The Answer: Quotient = 151 and Remainder =63

2.3.2. Division by Modern Method

The modern method of long division involves a series of steps to divide the dividend by the divisor. Let us go through the example provided step-by-step:

Example: 32226÷213

Step-by-Step Solution

1. Initial Setup

- Write the divisor (213) outside the division bracket and the dividend (32226) inside the bracket.
- Determine how many times 213 fits into the first few digits of the dividend. In this case, we start with the first three digits (322).

2. First Division

- 213 fits into 322 once. So, write 1 as the first digit of the quotient.
- Multiply 213 by 1 ($213 \times 1 = 213$).
- Subtract 213 from 322 ($322 - 213 = 109$).

3. Bring Down the Next Digit:

- Bring down the next digit from the dividend (2), making it 1092.

4. Second Division

- Determine how many times 213 fits into 1092. It fits 5 times ($213 \times 5 = 1065$).
- Write 5 as the next digit of the quotient.
- Subtract 1065 from 1092 ($1092 - 1065 = 27$).

5. Bring Down the Next Digit

- Bring down the next digit from the dividend (2), making it 276.

6. Third Division

- Determine how many times 213 fits into 276. It fits 1 time ($213 \times 1 = 213$).
- Write 1 as the next digit of the quotient.
- Subtract 213 from 276 ($276 - 213 = 63$).

7. Bring Down the Next Digit

- Bring down the last digit from the dividend (6), making it 63.

8. Final Remainder

- 213 does not fit into 63, so 63 is the remainder.

Therefore, the quotient is 151, and the remainder is 63. This process of repeatedly multiplying and subtracting continues until all digits of the dividend have been brought down and used.

2.4. Algebraic Part by Vedic Method and Modern Method

2.4.1. Algebraic Part by Vedic Method Using the Paravartya Additive Formula

The Paravartya formula, which means "transpose and apply," involves transposing terms by changing the signs. Specifically, positive signs are changed to negative and negative signs to positive.

In this method, except for the first digit of the divisor, the signs of the remaining digits are changed. The number of digits in the corrected divisor determines the position of a vertical line, which is drawn to separate that number of digits from the right side of the dividend. The variable terms and their constant terms are written separately and then reflected accordingly.

Example: ($3x^4 +3x^3 -7x^2 +2x +2$) by ($x^2 +3x +1$)

Solution:

So, quotient = $3x^2 - 6x +8$ remainder = $- 16x - 6$

2.4.2. Algebraic Part by Modern Method

In modern algebra, polynomial division can be performed using the long division method or synthetic division for specific types of divisors.

Example: ($3x^4 +3x^3 -7x^2 +2x +2$) by ($x^2 +3x +1$)

Solution:

Divisor Clause	Composite Clause	Remainder Clause
$x^2 +3x +1$	$3x^4 +3x^3 \ -7x^2$	$+2x \ \ +2$
	3 +3 -7 -9 -3 18	+2 +2 6 -24 -8
Modified Quotient	3 -6 8	- 16 -6

1. Divide the first term of the dividend ($3x^4$) by the first term of the divisor (x^2) to get the first term of the quotient ($3x^2$).
2. Multiply ($3x^2$) by the entire divisor ($x^2 + 3x + 1$):
   [$3x^2 \times (x^2 + 3x + 1) = 3x^4 + 9x^3 + 3x^2$]
3. Subtract this product from the original dividend:
   [$(3x^4 + 3x^3 - 7x^2 + 2x + 2) - (3x^4 + 9x^3 + 3x^2) = -6x^3 - 10x^2 + 2x + 2$]
4. Repeat the process with the new polynomial ($-6x^3 - 10x^2 + 2x + 2$).

By continuing this process, we determine the quotient and remainder of the division.

2.5. Binomial Theorem by Vedic Method and Modern Method

2.5.1. Binomial Theorem by Vedic Method (Using the Meruprastara Method)

The Vedic approach to the Binomial Theorem involves employing the Meruprastara method. Here is a structured explanation:

Identify Powers and Terms

Begin by identifying the powers and terms given in the binomial expression.

Calculate Multiples

To apply the Meruprastara method, determine the multiples of each term according to the powers specified in the problem statement.

Arrange Terms

Arrange the terms in a systematic way that aligns with the Vedic mathematical principles, typically involving the orderly display of powers and their corresponding coefficients.

Compute Values

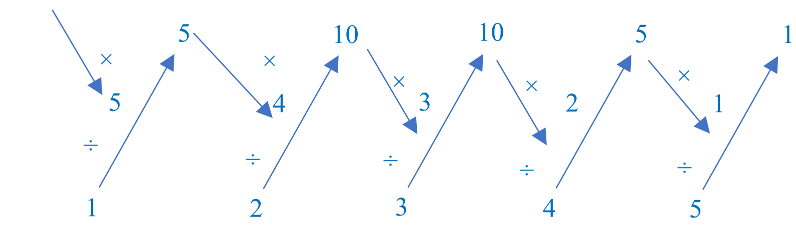
Compute the values of these multiples based on their respective powers, ensuring clarity and accuracy in representation.

Example: $(a + b)^5$ of the factors are:

First, we write reverse counting in the first row and write the straight counting in the second row.

5	4	3	2	1
1	2	3	4	5

Now, Write 1 in the first row, then multiply it by 5 and, divide it into the second row and write the next number.



1, (1×5÷1=5),(5×4÷2=10),(10×3÷3=10), (10×2÷4=5) , (5×1÷5=1)

Example: Find the value of $(1002)^5$.

Solution:

$a = 1$, $b = 002$

$(a+b)^5 = a^5 / 5a^4b / 10a^3b^2 / 10\ a^2b^3 / 5ab^4 / b^5$

$= (1)^5 / 5(1)^4(002) / 10(1)^3(002)^2 / 10(1)^2(002)^3 / 5(1)(002)^4 / (002)^5$

$= 1 / 5 \times 2 / 10 \times 4 / 10 \times 8 / 5 \times 16 / 32$

$= 1 / 010 / 040 / 080 / 080 / 032$

$= 1010040080080032$

2.5.2. Binomial Theorem by Modern Method

In modern mathematics, the Binomial Theorem is approached through systematic expansion and calculation, typically utilizing the formula:

$$(a+b)^n = \sum_{k=0}^{n} \binom{n}{k} a^{n-k} b^k$$

Where:

- $\binom{n}{k}$ Denotes the binomial coefficient, representing the number of ways to choose k elements from n elements.
- a and b are the terms of the binomial expression.
- n is the exponent or power to which the binomial is raised.

Steps Involved

Expansion

Expand the binomial expression using the binomial coefficients and the powers of aaa and bbb.

Calculate Coefficients

Determine the coefficients for each term in the expanded form, ensuring the correct application of the binomial coefficients.

Summation

Sum up all the terms to obtain the complete expanded form of the binomial expression.

Example: Find the value of (1002)5.

Solution: General Formula

$(a+b)^n = {}^nC_0a^nb^0 + {}^nC_1a^{n-1}b^1 + {}^nC_2a^{n-2}b^2 + {}^nC_3a^{n-3}b^3 + \ldots\ldots\ldots\ldots\ldots\ldots + {}^nC_na^0b^n$

According to the question, on writing 5 in place of n in the formula, because the power of the question is 5,

$(a+b)^5 = {}^5C_0a^5b^0 + {}^5C_1a^4b + {}^5C_2a^3b^2 + {}^5C_3a^2b^3 + {}^5C_4a^1b^4 + {}^5C_5a^0b^5$

$(1000+2)^5 = {}^5C_0\ (1000)^5(2)^0 + {}^5C_1\ (1000)^4(2)^1 + {}^5C_2\ (1000)^3(2)^2 + {}^5C_3\ (1000)^2(2)^3 + {}^5C_4(1000)\ )^1(2)^4 + {}^5C_5\ (1000)^0(2)^5$

$= 1\times1000000000000000\times1 + 5!\ \times1!\ \times1000000000000\times2 + 5!\ \times2!\ \times1000000000\times4 + 5!\ \times3!\ \times1000000\times8 + 5!\ \times4!\ \times1000\times16 + 1\times1\times32$

$= 1000000000000000\times1 + 5!\ \times4!\ \times1000000000000\times2 + 5\times4\times3!\ \times2\times1\times\ 1000000000\times4 + 5\times4\times3\times2!\ \times3\times2\times1000000\times8 + 5\times4\times3\times2\times1!\ \times4\times3\times2\ \times1000\times16 + 32$

$= 1000000000000000 + 10\times1000000000000 + 16000000000000 + 28800000 + 46080000 + 32$

$= 1010040080080032$

3. Conclusion

The Vedic method of mathematics, known for its simplicity and accessibility, offers a refreshing approach compared to modern methods. Historically, Indian mathematicians excelled as pioneering researchers, establishing mathematics as a practical and engaging subject. Vedic Mathematics, with its straightforward and engaging techniques, has transformed the perception of mathematics. Unlike traditional methods perceived as difficult and dull, Vedic Mathematics presents a user-friendly alternative that captivates learners, making math enjoyable and comprehensible. This approach helps alleviate the fear of mathematics among children, fostering a positive attitude towards learning.

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