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RESEARCH ARTICLE

COMPUTATION OF THE POWER OF BASE OF TWO DIGITS NUMBER USING KIFILIDEEN (MATRIX, COMBINATION AND DISTRIBUTIVE (MCD)) APPROACH

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ABSTRACT

The different methods used in the multiplication of numbers are long method (column method) of multiplication, grid methods and addition methods of multiplication. The utilization of the methods mentioned to solve power (index) of base number (number that multiply itself in a number of times) are horrendous, outrageous, tedious, time consuming and too long to be carried out. This study develops computation of the power of base of number using Kifilideen (matrix, combination and distributive (MCD)) approach. The Kif matrix method of multiplication is a shorter version of the long method (column method) of multiplication. The matrix method provides a straight forward, direct and systematic means of multiplication of digit number that multiply itself repetitively.

KEYWORDS

Multiplication, Kif matrix method, Column method, Grid method, Addition method, Long method.

1. INTRODUCTION

Multiplication emerges from day to day activities and everyday experience (Mcintosh and Ramagge, 2011). It is one of the four basic mathematics arithmetic operations while others are addition, subtraction and division (U.S. Department of Energy Washington, 1992; Rosenberg-Lee et. al., 2011). Solving multiplication problem is well known to be difficult among pupils in primary schools (Ahmad and Sivasubramaniam, 2010). The different methods used in the multiplication of numbers are long method (column method) of multiplication, grid methods and addition methods of multiplication. The utilization of the methods mentioned to solve power (index) of base number (number that multiply itself in a number of times) have been found tiring and almost discouraging. The grid method of multiplication is the splitting of the numbers to be multiplied into their component parts (process now called partitioning) and set out a grid comprising the component parts of one number along the top and the component parts of the other down the side. The grid method is reliable for those who struggle with calculation but it really isn't a great choice under time pressure.

Long or column method of multiplication is a written method of multiplying number (usually a two- or three-digit number by another large number). In long multiplication method, the number on the top is described as the multiplicand (Weisstein, 2020). The number by which it is multiplied, that is, the bottom number is called the multiplier (Hendron, 2012). The intermediate answer obtained is referred to as the partial product. The result of the product is called the product. The long multiplication is also known as column method of multiplication. The repetition in the multiplication of the multiplier with previous output makes the process look tedious, boring and too long to be carried out. Long method is not a straight forward and direct method of multiplication unlike matrix method of multiplication. Ahmad and Sivasubramaniam indicate that pupils in primary school has poor performance in multiplication problem because they have problems remembering all the basic multiplication facts, poor understanding of place value concept and could not follow up the long multiplication sequence (Ahmad and Sivasubramaniam, 2010). Some researchers applied array method to proffer solution to multi digit multiplication problems. This method depends mainly on counting (Chapin and Johnson, 2000; Hall, 1981). The tedious task in counting using this method does not make it possible to do with ease, for large number.

The matrix method of multiplication of numbers is developed from the long multiplication of numbers where each digit of the multiplicand is distributed to each digit of the multiplier. Matrix method is the arrangement of each of the multiplication in a row and column. It is a straight forward, direct and more systematic way of multiplication of digit number that multiply itself repeatedly. This method gives exact value of the simplification of large power of base number unlike the use of calculator which gives approximate value. It provides all the digits and the exact value of multiplication operation. The understanding and utilization of this matrix method of multiplication can be done effectively and applied at a very high speed by having more interaction with the procedure and method in doing it. As the saying, you can only know more about something when you continue having interaction with it (Osanyinpeju et. al., 2019). Keeping off will only make you know less from it (Osanyinpeju, 2020).

In the computation of power of base of two digits number $(ab)^n$ using matrix and combination give a straight forward and direct method of simplification. In general, the simplification of $(ab)^n$ gives $(n+1)\times 1$ matrix. Each element of the one column Kif matrix of the $(ab)^2$ is equal to each term in the binomial expansion of $(a+b)^2$ accordingly. This indicates that each element of the one column Kif matrix of the $(ab)^2$ can

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be used to obtained the series of the binomial expansion of (a+b)^2. Osanyinpeju used Kif matrix method of multiplication to solve wxyz × (11)^n which can be extended to other power of base of two digit number and still gives exact value of evaluation unlike calculator which gives approximate value of computation for large power of base number (Osanyinpeju, 2019; Osanyinpeju, 2020). This study developed computation of the power of base of number using matrix, combination and distributive approach.

2. Materials and Methods

2.1 Multiplication of one number with other using Kif matrix method (Kifilideen method of multiplication)

In general, the multiplication of one number with another using the matrix generates r× c matrix

$r = number\ of\ rows\ of\ the\ matrix\ generated$

$$r = n + m - 1 \quad (1)$$

$c = number\ of\ columns\ of\ the\ matricx\ generated$

$$c = n \quad (2)$$

Where n is the number of digits of the multiplic and m is the number of digits of the multiplier.

2.2 Multiplication of two digits number with one digit number using Kif matrix methods

In the multiplication of ab × c where ab is the multiplicand and c is the multiplier. The multiplicand has two digits while the multiplier has one digit. The number of element (e) in the matrix is 2. So,

$r\ =\ number\ of\ rows\ of\ the\ matrix\ (n + m - 1)$

$$r\ =\ 2 + 1 - 1\ =\ 2 \quad (3)$$

c = number of the columns of the matrix (n) = 2 (4)

e = the number of elements or terms in the matrix $e = n \times m = 2 \times 1 = 2$. (5)

Then the multiplication of ab × c produces 2× 2 matrix.

$$\begin{bmatrix} ac & \\ & bc \end{bmatrix} = \begin{bmatrix} ac \\ bc \end{bmatrix} \quad (6)$$

Each digit of the multiplicand is distributed to each digit of the multiplier. Each term of the distribution of the first digit of the multiplicand is arranged down the column of the matrix starting from the first row first column of the matrix. Afterward, the second digit of the multiplicand is distributed to each digit of the multiplier. The results of each term obtained are arranged down the column of the matrix starting from the second row second column of the matrix. More so, all terms in each row are added together separately.

2.3 Illustration of multiplication of two digits number with one digits number using Kifilideen matrix method of multiplication

On average the number of sprouts developed on each yam tuber placed in a laboratory for experimental study is 7. If the total number of the yam tuber is 85. Determine the total number of sprouts generated by the 85 yam tubers.

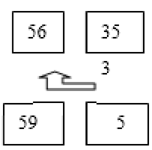
2.3.1 Solution

Number sprout per tuber = s = 7 and Number of yam tuber = y = 85
Total number of the yam tuber = y × s

Total number of the yam tuber = 85 × 7 (7)

Total number of the yam tuber $= \begin{bmatrix} 8 \times 7 & \\ & 5 \times 7 \end{bmatrix}$ (8)

Total number of the yam tuber $= \begin{bmatrix} 56 \\ 35 \end{bmatrix}$ (9)



The total number of sprouts generated by the 85 yam tubers = 85 ×7= 595 (10)

2.4 Multiplication of two digits number with two digits number using kif matrix methods of multiplication

In the multiplication of ab × cd where ab is the multiplicand and cd is the multiplier. The multiplier has two digits while the multiplier has two digits. The number of digits of the multiplicand (n=2) and multiplier (m=2) is 3. So,

$r\ =\ number\ of\ rows\ of\ the\ matrix\ (n + m - 1)$

$$r\ =\ 2 + 2 - 1\ =\ 3 \quad (11)$$

c = number of the columns of the matrix (n) = 2 (12)

Then the multiplication of ab × cd generates 3 × 2 matrix.

$$\begin{bmatrix} ac & + & \\ ad & + & bc \\ & & bd \end{bmatrix} = \begin{bmatrix} ac \\ ad + bc \\ bd \end{bmatrix} \quad (13)$$

Each digit of the multiplicand is distributed to each digit of the multiplier. Each term of the distribution of the first digit of the multiplicand is arranged down the column of the matrix starting from the first row first column of the matrix. Afterward, the second digit of the multiplicand is distributed to each digit of the multiplier. The results of each term obtained are arranged down the column of the matrix starting from the second row second column of the matrix. More so, each term in each row is added together separately.

2.5 Demonstration of multiplication of two digits number with two digits number using matrix methods

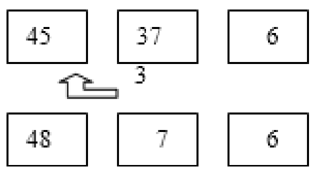
A poultry egg incubator has a capacity of 100. If after 21 days of hatchability the total number of the egg hatch is 92 and the average weight of each chick is 53 g. Determine the total weight of the chicks that hatch.

2.5.1 Solution

Number of egg that hatched = c = 92 and Average weight of each chick = w = 53 g

Total weight of the chicks that hatched in the incubator = c × w =92 × 53 (14)

$$92 \times 53 = \begin{bmatrix} 9 \times 5 & & \\ 9 \times 3 & + & 2 \times 5 \\ & & 2 \times 3 \end{bmatrix} = \begin{bmatrix} 45 \\ 37 \\ 6 \end{bmatrix} \quad (15)$$



Total weight of the chicks that hatched in the incubator = 92 × 53=4,876 g (16)

The matrix produces three rows which led to the three boxes.

2.6 Multiplication of four digits number with three digits number using matrix methods

In the multiplication of abcd × xyz where abcd is the multiplicand and xyz is the multiplier. The multiplier has four digits while the multiplier has three digits. The number of digits of the multiplicand (n=4) and multiplier (m=3) is 7. It generates elements or terms.

$r\ =\ number\ of\ rows\ of\ the\ matrix\ (n + m - 1)$

$$r\ =\ 4 + 3 - 1\ =\ 6 \quad (17)$$

c = number of the columns of the matrix (n) = 4 (18)

e = n × m = 4 × 3 = 12 (19)

$$\begin{bmatrix} ax & & & \\ ay & +\ bx & & \\ az & +\ by & +\ cx & \\ & bz & +\ cy & +dx \\ & & cz & +dy \\ & & & dz \end{bmatrix} = \begin{bmatrix} ax \\ ay+bx \\ az+by+cx \\ bz+cy+dx \\ cz+dy \\ dz \end{bmatrix} \quad (20)$$

Each digit of the multiplicand is distributed to each digit of the multiplier. Each term of the distribution of the first digit of the multiplicand (a) on to each digit of the multiplier is arranged down the column of the matrix starting from the first row first column of the matrix. Afterward, the second digit of the multiplicand (b) is distributed to each digit of the multiplier. The results of each term obtained are arranged down the column of the matrix starting from the second row second column of the matrix. The third digit of the multiplicand (c) is distributed to each digit of the multiplier.

Each term of the distribution is arranged down the column of the matrix starting from the third row third column of the matrix. The fourth digit of the multiplicand (d) is distributed to each digit of the multiplier. Each term of the distribution is arranged down the column of the matrix starting from the fourth row fourth column of the matrix. More so, each term in each row is added together separately.

2.7 Example on multiplication of four digits number with three digits number using Kifilideen matrix methods of multiplication

In other to lift a set of 8402 electric motor in a container with each electric motor having an average weight of 24.5 kg a heavy-duty crane is used. Determine the minimum force required to lift the set of the electric motor.

2.7.1 Solution

Each mass of the electric motor = m = 24.5 g and Number of the electric motor = n = 8402

Total mass of the set of the electric motor = M = mn

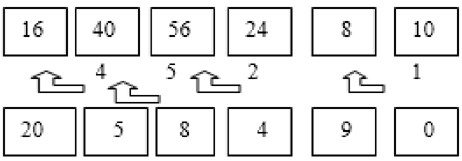
Weight of the electric motor = Mg = mng

Weight of the electric motor = 24.5× 8402 × 10 (21)

Weight of the electric motor= 8402× 245 (22)

$$8402 \times 245 = \begin{bmatrix} 8\times 2 & & & \\ 8\times 4 & +4\times 2 & & \\ 8\times 5 & +4\times 4 & +\ 0\times 2 & \\ & 4\times 5 & +\ 0\times 4 & +2\times 2 \\ & & 0\times 5 & +2\times 4 \\ & & & 2\times 5 \end{bmatrix} \quad (23)$$

$$8402 \times 245 = \begin{bmatrix} 16 \\ 40 \\ 56 \\ 24 \\ 8 \\ 10 \end{bmatrix} \quad (24)$$



Weight of the electric motor = 8402× 245 = 2058490 *or* 2.058490 × 10^6 *Newtons* (25)

2.8 Multiplication of four digits number with four digits number using Kif matrix methods

In the multiplication of abcd × wxyz where abcd is the multiplicand and wxyz is the multiplier. The multiplier has four digits while the multiplier has four digits. The number of digits of the multiplicand (n=4) and multiplier (m=4) is 8.

$r\ =\ number\ of\ rows\ of\ the\ matrix\ (n+m-1)$

$r = 4+4-1 = 7$ (26)

c = number of the columns of the matrix (n)

$c = n = 4$ (27)

$$\begin{bmatrix} aw & & & \\ ax & +\ bw & & \\ ay & +\ bx & +\ cw & \\ az & +by & +\ cx+ & dw \\ & bz & +\ cy+ & dx \\ & & cz\ + & dy \\ & & & dz \end{bmatrix} = \begin{bmatrix} aw \\ ax+bw \\ ay+\ bx\ +cw \\ az\ +by\ +\ cx+\ dw \\ bz\ \ +cy+\ dx \\ cz\ +\ dy \\ dz \end{bmatrix}$$

Then the multiplication of abcd × $wxyz$ generates 7 × 4 matrix.

2.9 Application of Multiplication of four digits number with four digits number using matrix methods (Kifilideen method of multiplication)

The density of substance to be shipped to a country for a research work is 3567 kg/m^3 and the volume of the substance is 8641m^3. Determine the mass of the substance to be shipped.

2.9.1 Solution

The density of substance = ρ

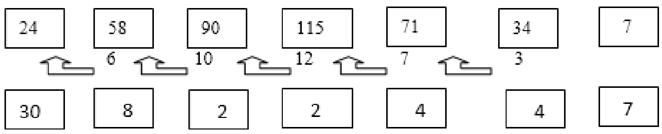
The density of substance = 3567 kg/m^3 and Volume of the substance = V

Volume of the substance = 8641m^3

Mass of the substance = ρ V (28)

Mass of the substance = 3567 kg/m³ × 8641m³

$$3567\ kg/m^3 \times 8641m^3 = \begin{bmatrix} 3\times 8 & & & \\ 3\times 6 & +5\times 8 & & \\ 3\times 4 & +5\times 6 & +\ 6\times 8 & \\ 3\times 1+5\times 4 & +\ 6\times 6+ & 7\times 8 & \\ & 5\times 1\ +\ 6\times 4+7\times 6 & & \\ & & 6\times 1+7\times 4 & \\ & & & 7\times 1 \end{bmatrix} = \begin{bmatrix} 24 \\ 58 \\ 90 \\ 115 \\ 71 \\ 34 \\ 7 \end{bmatrix} \quad (29)$$



Mass of the substance = 3567 × 8641 (30)

Mass of the substance = 30822447 *or* 3.0822447 × $10^7 Kg$ (31)

The matrix produces seven rows which led to the seven boxes.

2.10 Computation of power of base number using matrix and combination method (Kif method of multiplication)

In the computation of power of base of two digits number $(ab)^n$ using matrix and combination give a straight forward and direct method of simplification. In general, the simplification of $(ab)^n$ gives $l \times k$ matrix. Where, l = the number of rows of the matrix

$l = n + 1$ (32)

k = the number of columns of the matrix

$k = 1$ (33)

n = the power or index of the base number (34)

$$(ab)^n = \begin{bmatrix} {}^{n}_{0}C \times a^n \times b^0 \\ {}^{n}_{1}C \times a^{n-1} \times b^1 \\ {}^{n}_{2}C \times a^{n-2} \times b^2 \\ {}^{n}_{3}C \times a^{n-3} \times b^3 \\ . \\ . \\ . \\ {}^{n}_{n-2}C \times a^2 \times b^{n-2} \\ {}^{n}_{n-1}C \times a^1 \times b^{n-1} \\ {}^{n}_{n}C \times a^0 \times b^n \end{bmatrix} \quad (35)$$

2.11 Analysis of the computation of power of base number using matrix and combination method (Kif method of multiplication

Compute the following using Kif matrix method

$[i]$ 52^3 $[ii]$ $23^{\,11}$

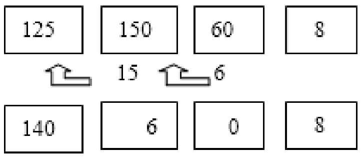
2.11.1 Solution

$[i]$ The computation of 52^3 gives 4×1 *matrix* that is 4 rows and one column matrix.

$$52^6 = \begin{bmatrix} {}^{3}_{0}C \times 5^3 \times 2^0 \\ {}^{3}_{1}C \times 5^2 \times 2^1 \\ {}^{3}_{2}C \times 5^1 \times 2^2 \\ {}^{3}_{3}C \times 5^2 \times 2^3 \end{bmatrix} = \begin{bmatrix} 1 \times 5^3 \times 2^0 \\ 3 \times 5^2 \times 2^1 \\ 3 \times 5^1 \times 2^2 \\ 1 \times 5^0 \times 2^3 \end{bmatrix} \quad (36)$$

$$52^6 = \begin{bmatrix} 125 \\ 150 \\ 60 \\ 8 \end{bmatrix} \quad (37)$$

It gives a 4 rows matrix which makes 4 boxes.



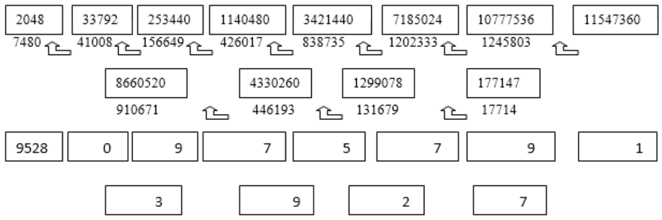
$$52^3 = 140608 \text{ or } 1.40608 \times 10^{\,5} \quad (38)$$

$[ii]$ The computation of $23^{\,11}$ gives (11+1) $\times 1$ *matrix or* 12×1 *matrix* that is 12 rows and one column matrix.

$$23^{11} = \begin{bmatrix} {}^{11}_{0}C \times 2^{11} \times 3^0 \\ {}^{11}_{1}C \times 2^{10} \times 3^1 \\ {}^{11}_{2}C \times 2^9 \times 3^2 \\ {}^{11}_{3}C \times 2^8 \times 3^3 \\ {}^{11}_{4}C \times 2^7 \times 3^4 \\ {}^{11}_{5}C \times 2^6 \times 3^5 \\ {}^{11}_{6}C \times 2^5 \times 3^6 \\ {}^{11}_{7}C \times 2^4 \times 3^7 \\ {}^{11}_{8}C \times 2^3 \times 3^8 \\ {}^{11}_{9}C \times 2^2 \times 3^9 \\ {}^{11}_{10}C \times 2^1 \times 3^{10} \\ {}^{11}_{11}C \times 2^0 \times 3^{11} \end{bmatrix} = \begin{bmatrix} 1 \times 2^{11} \times 3^0 \\ 11 \times 2^{10} \times 3^1 \\ 55 \times 2^9 \times 3^2 \\ 165 \times 2^8 \times 3^3 \\ 330 \times 2^7 \times 3^4 \\ 462 \times 2^6 \times 3^5 \\ 462 \times 2^5 \times 3^6 \\ 330 \times 2^4 \times 3^7 \\ 165 \times 2^3 \times 3^8 \\ 55 \times 2^2 \times 3^9 \\ 11 \times 2^1 \times 3^{10} \\ 1 \times 2^0 \times 3^{11} \end{bmatrix} \quad (39)$$

$$23^{11} = \begin{bmatrix} 2,048 \\ 33,792 \\ 253,440 \\ 1,140,480 \\ 3,421,440 \\ 7,185,024 \\ 10,777,536 \\ 11,547,360 \\ 8,660,520 \\ 4,330,260 \\ 1,299,078 \\ 177,147 \end{bmatrix} \quad (40)$$

It gives a 12 rows matrix which makes 12 boxes.



$$23^{11} = 952,809,757,913,927 \text{ or } 9.525809757913927 \times 10^{14} \quad (41)$$

2.12 Computation of two digits number with power of base of two digits number using kif matrix and combination method

In the computation of two digits number xy multiply by power of base of two digits number $(ab)^n$ using matrix and combination method give a straight forward and direct method of simplification. In general, the simplification of xy $\times$ $(ab)^n$ gives $l \times k$ matrix. Where xy is the multiplicand and $(ab)^n$ is the multiplier. The number of digits of the multiplicand is represented by m which is two.

Also, $l =$ the number of rows of the matrix

$$l = n + m = n + 2 \quad (42)$$

$k =$ the number of columns of the matrix = $mk2$ (43)

$n =$ the power or index of the base number (44)

m =number of digits of the multiplicand (45)

So, the xy $\times$ $(ab)^n$ generates $(n+2) \times 2$ matrix

$$\text{xy} \times (ab)^n = \begin{bmatrix} {}^{n}_{0}C \times a^n \times b^0 \times x & \\ {}^{n}_{1}C \times a^{n-1} \times b^1 \times x & + \; {}^{n}_{0}C \times a^n \times b^0 \times y \\ {}^{n}_{2}C \times a^{n-2} \times b^2 \times x & + \; {}^{n}_{2}C \times a^{n-1} \times b^2 \times y \\ {}^{n}_{3}C \times a^{n-3} \times b^3 \times x & + \; {}^{n}_{3}C \times a^{n-2} \times b^3 \times y \\ & . \\ & . \\ & . \\ {}^{n}_{n-2}C \times a^2 \times b^{n-2} \times x & + \; {}^{n}_{n-3}C \times a^2 \times b^{n-3} \times y \\ {}^{n}_{n-1}C \times a^2 \times b^{n-1} \times x & + \; {}^{n}_{n-2}C \times a^2 \times b^{n-2} \times y \\ {}^{n}_{n}C \times a^1 \times b^n \times x & + \; {}^{n}_{n-1}C \times a^2 \times b^{n-1} \times y \\ & {}^{n}_{n}C \times a^0 \times b^n \times y \end{bmatrix} \quad (46)$$

$$\text{xy} \times (ab)^n = \begin{bmatrix} {}^{n}_{0}C \times a^n \times b^0 \times x \\ {}^{n}_{1}C \times a^{n-1} \times b^1 \times x + {}^{n}_{0}C \times a^n \times b^0 \times y \\ {}^{n}_{2}C \times a^{n-2} \times b^2 \times x + {}^{n}_{2}C \times a^{n-1} \times b^2 \times y \\ {}^{n}_{3}C \times a^{n-3} \times b^3 \times x + {}^{n}_{3}C \times a^{n-2} \times b^3 \times y \\ . \\ . \\ . \\ {}^{n}_{n-2}C \times a^2 \times b^{n-2} \times x + {}^{n}_{n-2}C \times a^2 \times b^{n-3} \times y \\ {}^{n}_{n-2}C \times a^2 \times b^{n-1} \times x + {}^{n}_{n-2}C \times a^2 \times b^{n-2} \times y \\ {}^{n}_{n-1}C \times a^1 \times b^n \times x + {}^{n}_{n-2}C \times a^2 \times b^{n-1} \times y \\ {}^{n}_{n}C \times a^0 \times b^n \times y \end{bmatrix} \quad (47)$$

Each digit of the multiplicand is distributed to each expansion of the multiplier. Each term of the distribution of the first digit of the multiplicand (x) is arranged down the column of the matrix starting from the first row first column of the matrix. Afterward, the second digit of the multiplicand (y) is distributed to each expansion of the multiplier. The results of each term obtained are arranged down the column of the matrix starting from the second row second column of the matrix. More so, the each term in each row is added together separately.

2.13 Illustration on the computation of two digits number with power of base of two digits number using kif matrix and combination method

Compute the following using Kif matrix method

$[i]$ $68 \times 72^{\,5}$
$[i]$ The solution of $68 \times 72^{\,5}$ is a 7×2 matrix

$$68 \times 72^{5} = \begin{bmatrix} {}^{5}_{0}C \times 7^5 \times 2^0 \times 6 & \\ {}^{5}_{1}C \times 7^4 \times 2^1 \times 6 \; + & {}^{5}_{0}C \times 7^5 \times 2^0 \times 8 \\ {}^{5}_{2}C \times 7^3 \times 2^2 \times 6 \; + & {}^{5}_{1}C \times 7^4 \times 2^1 \times 8 \\ {}^{5}_{3}C \times 7^2 \times 2^3 \times 6 \; + & {}^{5}_{2}C \times 7^3 \times 2^2 \times 8 \\ {}^{5}_{4}C \times 7^1 \times 2^4 \times 6 \; + & {}^{5}_{3}C \times 7^2 \times 2^3 \times 8 \\ {}^{5}_{5}C \times 7^0 \times 2^5 \times 6 \; + & {}^{5}_{4}C \times 7^1 \times 2^4 \times 8 \\ & {}^{5}_{5}C \times 7^0 \times 2^5 \times 8 \end{bmatrix} \quad (48)$$

$$68 \times 72^{5} = \begin{bmatrix} 100842 \\ 278516 \\ 274400 \\ 133280 \\ 34720 \\ 4672 \\ 256 \end{bmatrix} \quad (49)$$

100842	278516	274400	133280	34720	4672	256
	30732	28807	13679	3518	469	25
131574	3	9	8	9	7	6

It gives a 7 rows matrix which makes 7 boxes

$$42 \times 72^{5} = 131,574,398,976 \text{ or } 1.31574398976 \times 10^{11} \quad (50)$$

2.14 Computation of four digits number with power of base of two digits number using kif matrix and combination method

In the computation of two digits number wxyz with power of base of two digits number $(ab)^n$ using matrix and combination method give exact value not the approximate value. In general, the simplification of wxyz $\times (ab)^n$ gives $l \times k$ matrix. Where xy is the multiplicand and $(ab)^n$ is the multiplier. The number of digits of the multiplicand is represented by m which is four.

Also, $l =$ the number of rows of the matrix

$$l = n + m = n + 4 \quad (51)$$

$k =$ the number of columns of the matrix

$$k = m = 4 \quad (52)$$

Where, $n =$ the power or index of the base number

$m =$number of digits of the multiplicand

So, the wxyz $\times (ab)^n$ generates $(n+4) \times 4$ matrix

wxyz $\times (ab)^n =$

$$\begin{bmatrix} {}^{n}_{0}C \times a^n \times b^0 \times w & & & \\ {}^{n}_{1}C \times a^{n-1} \times b^1 \times w \; + & {}^{n}_{0}C \times a^n \times b^0 \times x & & \\ {}^{n}_{2}C \times a^{n-2} \times b^2 \times w \; + & {}^{n}_{1}C \times a^{n-1} \times b^1 \times x \; + & {}^{n}_{0}C \times a^n \times b^0 \times y & \\ {}^{n}_{3}C \times a^{n-3} \times b^3 \times w \; + & {}^{n}_{2}C \times a^{n-2} \times b^2 \times x \; + & {}^{n}_{1}C \times a^{n-1} \times b^1 \times y \; + & {}^{n}_{0}C \times a^n \times b^0 \times z \\ {}^{n}_{4}C \times a^{n-4} \times b^4 \times w \; + & {}^{n}_{3}C \times a^{n-3} \times b^3 \times x \; + & {}^{n}_{1}C \times a^{n-2} \times b^2 \times y \; + & {}^{n}_{0}C \times a^{n-1} \times b^1 \times z \\ & \vdots & & \\ {}^{n}_{n-4}C \times a^4 \times b^{n-4} \times w \; + & {}^{n}_{n-5}C \times a^5 \times b^{n-5} \times x \; + & {}^{n}_{n-6}C \times a^6 \times b^{n-6} \times y \; + & {}^{n}_{n-7}C \times a^7 \times b^{n-7} \times z \\ {}^{n}_{n-3}C \times a^3 \times b^{n-3} \times w \; + & {}^{n}_{n-4}C \times a^4 \times b^{n-4} \times x \; + & {}^{n}_{n-5}C \times a^5 \times b^{n-5} \times y \; + & {}^{n}_{n-6}C \times a^6 \times b^{n-6} \times z \\ {}^{n}_{n-2}C \times a^2 \times b^{n-2} \times w \; + & {}^{n}_{n-3}C \times a^3 \times b^{n-3} \times x \; + & {}^{n}_{n-4}C \times a^4 \times b^{n-4} \times y \; + & {}^{n}_{n-5}C \times a^5 \times b^{n-5} \times z \\ {}^{n}_{n-1}C \times a^1 \times b^{n-1} \times w \; + & {}^{n}_{n-2}C \times a^2 \times b^{n-2} \times x \; + & {}^{n}_{n-3}C \times a^3 \times b^{n-3} \times y \; + & {}^{n}_{n-4}C \times a^4 \times b^{n-4} \times z \\ {}^{n}_{n}C \times a^0 \times b^n \times w \; + & {}^{n}_{n-1}C \times a^1 \times b^{n-1} \times x \; + & {}^{n}_{n-2}C \times a^2 \times b^{n-2} \times y \; + & {}^{n}_{n-3}C \times a^3 \times b^{n-3} \times z \\ & {}^{n}_{n}C \times a^0 \times b^n \times x \; + & {}^{n}_{n-1}C \times a^1 \times b^{n-1} \times y \; + & {}^{n}_{n-2}C \times a^2 \times b^{n-2} \times z \\ & & {}^{n}_{0}C \times a^n \times b^0 \times y \; + & {}^{n}_{n-1}C \times a^1 \times b^{n-1} \times z \\ & & & {}^{n}_{n}C \times a^0 \times b^n \times z \end{bmatrix}$$

Each digit of the multiplicand is distributed to each expansion of the multiplier. Each term of the distribution of the first digit of the multiplicand (w) is arranged down the column of the matrix starting from the first row first column of the matrix. Afterward, the second digit of the multiplicand (x) is distributed to each expansion of the multiplier. The results of each term obtained are arranged down the column of the matrix starting from the second row second column of the matrix. Each term of the distribution of the third digit of the multiplicand (y) is arranged down the column of the matrix starting from the third row third column of the matrix. Afterward, the fourth digit of the multiplicand (z) is distributed to each expansion of the multiplier. The results of each term obtained are arranged down the column of the matrix starting from the fourth row fourth column of the matrix. More so, the each term in each row is added together separately.

2.15 Display of computation of four digits number with power of base of two digits number using kif matrix and combination method

Compute the following using Kifilideen matrix method

$[i]$ 1513×56^{4}

2.15.1 Solution

$[i]$ The solution of 1513×56^{4} is a 8×4 matrix

$$1513 \times 56^{4} = \begin{bmatrix} {}^{4}_{0}C \times 5^4 \times 6^0 \times 1 & & & \\ {}^{4}_{1}C \times 5^3 \times 6^1 \times 1 \; + & {}^{4}_{0}C \times 5^4 \times 6^0 \times 5 & & \\ {}^{4}_{2}C \times 5^2 \times 6^2 \times 1 \; + & {}^{4}_{1}C \times 5^3 \times 6^1 \times 5 \; + & {}^{4}_{0}C \times 5^4 \times 6^0 \times 1 & \\ {}^{4}_{3}C \times 5^1 \times 6^3 \times 1 \; + & {}^{4}_{2}C \times 5^2 \times 6^2 \times 5 \; + & {}^{4}_{1}C \times 5^3 \times 6^1 \times 1 \; + & {}^{4}_{0}C \times 5^4 \times 6^0 \times 3 \\ {}^{4}_{4}C \times 5^0 \times 6^4 \times 1 \; + & {}^{4}_{3}C \times 5^1 \times 6^3 \times 5 \; + & {}^{4}_{2}C \times 5^2 \times 6^2 \times 1 \; + & {}^{4}_{1}C \times 5^3 \times 6^1 \times 3 \\ & {}^{4}_{4}C \times 5^0 \times 6^4 \times 5 \; + & {}^{4}_{3}C \times 5^1 \times 6^3 \times 1 \; + & {}^{4}_{2}C \times 5^2 \times 6^2 \times 3 \\ & & {}^{4}_{4}C \times 5^0 \times 6^4 \times 1 \; + & {}^{4}_{3}C \times 5^1 \times 6^3 \times 3 \\ & & & {}^{4}_{4}C \times 5^0 \times 6^4 \times 3 \end{bmatrix}$$

(52)

$$1503 \times 56^{4} = \begin{bmatrix} 625 \\ 6125 \\ 21025 \\ 36195 \\ 37296 \\ 27000 \\ 14256 \\ 648 \end{bmatrix} \quad (53)$$

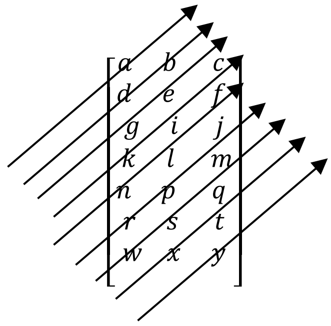
625	6125	21025	36195	37296	27000	14256	3888
	862	2504	4020	4014	2846	1464	388
1487	9	5	9	2	4	4	8

It gives a 8 rows matrix which makes 8 boxes

$$1503 \times 56^{4} = 14,879,592,448 \text{ or } 1.4879592448 \times 10^{10} \quad (54)$$

2.16 Kif Arrow alternative for final value computation

Aligning all digits within the matrix in their place value position, we can alternatively use the Kif's arrow method to arrive at the answers. And also, using the zero padding of null values to augment for less digit values. The Kif arrow alternative for final value computation is illustrated in the kif matrix below:



In the above kif matrix of the digits numbers of the first row to the last row are abc, def, gij, klm, mpq, rst and wxy respectively. For the final answer of computation starting the digits from the left side of the answer we have $y, x+t, w+s+q, r+p+m, n+l+j, k+i+f, g+e+c, d+b$,

a. If the summation of the digit in a particular arrow gives result more than one digit we write down the last digit and carry and add the other digit to the next up arrow. So we have the answer has

$a, d+b, g+e+c, k+i+f, n+l+j, r+p+m,$
$w+s+q, x+t, y.$

2.17 Demonstration on the using of the Kif arrow alternative for final value computation

In an analysis of a pandemic outbreak of COVID-19 of corona virus carried out in a particular Country the average number of new cases of people which show the symptoms of the disease per day is 96. Determine the total number of cases of the people infected by the virus after 78 days.

2.17.1 Solution

Average number of people infected per day = n = 96

Number of day to be evaluated = d = 78 days

Total number of people infected after the 78 days
= n× d = 96× 78 (55)

$$\text{Total people infected} = \begin{bmatrix} 9\times 7 & \\ 9\times 8\ +\ 6\times 7 & \\ & 6\times 8 \end{bmatrix} \quad (56)$$

$$\text{Total number of people infected} = \begin{bmatrix} 0 & 6 & 3 \\ 1 & 1 & 4 \\ 0 & 4 & 8 \end{bmatrix} \quad (57)$$

$$= \begin{bmatrix} 0 & 6 & 3 \\ 1 & 1 & 4 \\ 0 & 4 & 8 \end{bmatrix}$$

$Arrow\ 1\ =\ 8, Arrow\ 2 =\ 4 +\ 4 = 8,$

$Arrow\ 3 = 0 + 1 + 3 = 4, Arrow\ 4 = 1 + 6 = 7$

$Arrow\ 5 = 0$

So,

Total number of people infected $= 07488 = 7,488$

A worker spends £ 546 every day to work. Calculate the total amount of money spend to work after 67 days.

2.17.2 Solution

Amount of money spend per day = m = £ 546 (58)

Number day to be estimated = n = 67 days (59)

Total amount of money to be spend = m × n (60)

Total amount of money to be spend = 546 × 67 (61)

$$\text{Total amount} = \begin{bmatrix} 5\times 6 & \\ 5\times 7\ +\ 4\times 6 & \\ & 4\times 7 + 6\times 6 \\ & 6\times 7 \end{bmatrix} \quad (62)$$

$$\text{Total amount} = \begin{bmatrix} 3 & 0 \\ 5 & 9 \\ 6 & 4 \\ 4 & 2 \end{bmatrix} = \begin{bmatrix} 3 & 0 \\ 5 & 9 \\ 6 & 4 \\ 4 & 2 \end{bmatrix} \quad (63)$$

$Arrow\ 1\ =\ 2, Arrow\ 2 =\ 4 +\ 4 = 8,$
$Arrow\ 3 = 6 + 9 = 15, Arrow\ 4 = 5 + 0 = 5$
$Arrow\ 5 = 3$

Arrow 3 is more than one digit, so the last digit that is 5 would be recorded down while the other digit that is 1 would be transferred and added up to the next arrow. This makes the value of the fourth arrow to be 6.

So, we have

Total amount $= 36,582$

3. Discussion

In general the multiplication of n-digits number with m-digits number using Kif Matrix method generates $(n + m - 1) \times n$ matrix where n-digits number is the multiplicand and the m-digits is the multiplier.

4. Conclusion

This study develops computation of the power of base of number using Kifilideen (matrix, combination and distributive) approach. The Kif matrix method of multiplication is a shorter version of the long method (column method) of multiplication. The matrix method provides a straight forward, direct and systematic means of multiplication of digit number that multiply itself repetitively.

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