Fast Multiplication using Vedic Math

Soumye Singhal

6 March 2017

Contents

1 Introduction

Traditional long mulitplication method takes a lot of time and are also generally difficult to carry out accurately and fastly in the head [3]. For more details on the long division method go to : `http://mathworld.wolfram.com/LongMultiplication.html`. There are various methods given in vedas to multiply some specific type of 2-digit numbers very quickly. Two such examples are listed below. [1] [2]

TYPE	DESCRIPTION
Type I	Two digit numbers with first digit same, and the last ones add up to 10.
Type II	Two digit numbers with first digit add up to 10, and the last ones are same.

Table 1: Table of Types

2 Type I

2.1 Algorithm

```
procedure MULTIPLICATION(a, b)
    c ← a/10                                  ▷ First digit of the first number
    d ← a mod 10                              ▷ Second digit of the first number
    e ← b/10                                  ▷ First digit of the second number
    f ← b mod 10                              ▷ Second digit of the second number
    if c == e & d + f = 10 then
        Part1 ← c × (c + 1)
        Part2 ← d × f
        Product ← Part1 × 100 + Part2         ▷ Combining the two products
        return Product
    else
        return Not of Type I
    end if
end procedure
```

2.2 MindMap for Mental Calculation

Using the algorithm given in 2.1 we can carry out this method in our mind in a way similar to the mindmap given in 2.2

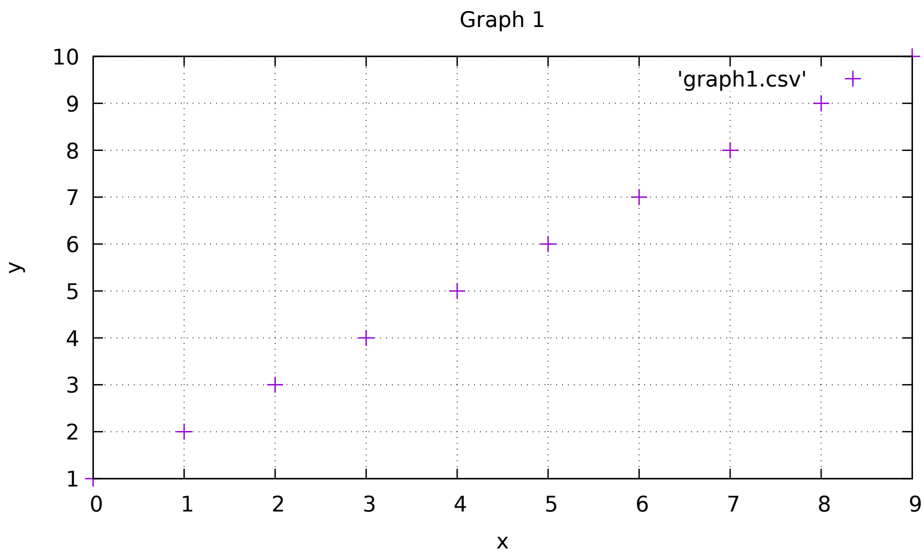

Figure 1: Type I

2.3 Algebraic Explanation

We now present an algebraic explanation as to why the above stated algorithm works. Consider these two digit numbers as ab and $a(10-b)$. Note that the first common digit is a and the second digits are b and 10-b respectively.

$$\begin{aligned} ab \times a(10-b) &= (10a+b)(10a+10-b) \\ &= 100a^2 + 100a - 10a \times b + 10a \times b + 10 \times b - b^2 \\ &= 100a \times (a+1) + b \times (10-b) \\ &= a \times (a+1) \mid b \times (10-b) \end{aligned}$$

2.4 Extension

For general case we can assume the product of two n digit numbers whose first k digits are same such that $k < n$ and the rest of n-k digit is such that the sum for both numbers in 10^{n-k}. Then again the product will be the concatenation of product of number formed by first k digits and its successor and product of number formed by rest of the digit and its subtraction from 10^{n-k} `http://www.vedantatree.com/2012/05/vedic-math-multiplication-of-numbers.html`

3 Type II

3.1 Algorithm

```
procedure MULTIPLICATION(a, b)
    c ← a/10                          ▷ First digit of the first number
    d ← a  mod 10                     ▷ Second digit of the first number
    e ← b/10                          ▷ First digit of the second number
    f ← b  mod 10                     ▷ Second digit of the second number
    if d = f & c + e = 10 then
        Part1 ← c × e + d
        Part2 ← d × f
        Product ← Part1 × 100 + Part2 ▷ Combining the two products
        return Product
    else
        return Not of Type II
    end if
end procedure
```

3.2 MindMap for Mental Calculation

Using the algorithm given in 3.1 we can carry out this method in our mind in a way similar to the mindmap given in 3.2 [1]

[1]Note: Here we assume that the person is comfortable with 1 digit multipliction.

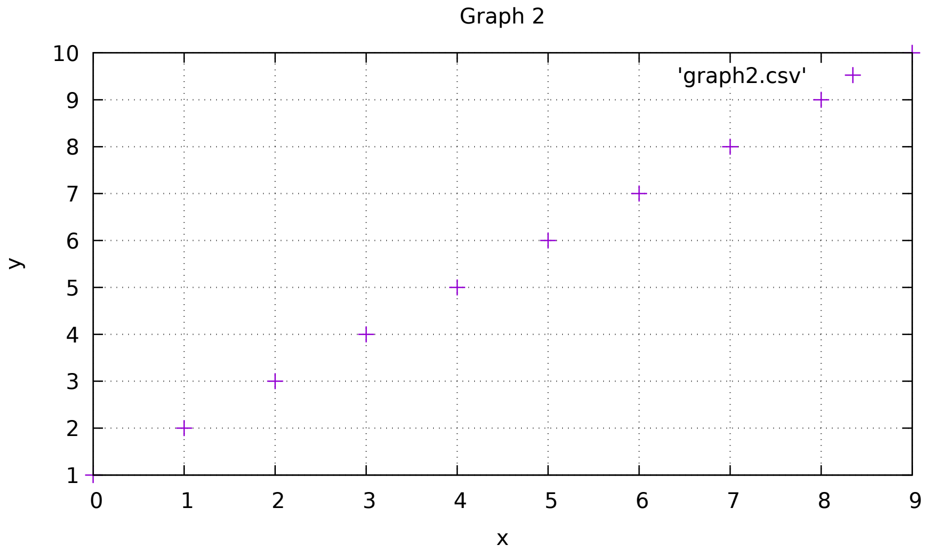

Figure 2: Type II

3.3 Algebraic Explanation

We now give an algebraic explanation as to why the above stated algorithm works. Consider these two digit numbers as ab and $(10-a)b$. Note that the second common digit is b and the first digits are a and 10-a respectively.

$$\begin{aligned} ab \times (10-a)b &= (10a+b)(10(10-a)+b) \\ &= (10a+b)(100-10a+b) \\ &= 1000a - 100a^2 + 10a \times b + 100b - 10a \times b + b^2 \\ &= 100(10a - a^2 + b) + b^2 \\ &= 100(a(10-a)+b) + b^2 \\ &= a(10-a) + b \mid b^2 \end{aligned}$$

3.4 Extension

For general case we can assume the product of two n digit numbers whose last k digits are same such that $k < n$ and the rest of n-k digit is such that the sum for both numbers in 10^{n-k}. Then again the product will be the concatenation of product of number formed by first k digits added with the last k digits and the square of number formed by rest of the digit. `http://www.vedantatree.com/2012/05/vedic-math-multiplication-of-numbers.html`

4 Why these Methods are Faster

In regular multiplication of two 2-digit numbers we need to do 4 1-1 digit multiplications. But in this shorter method we need to only do 2 1-1 digit multiplications and 2 simple additions. This makes it less time consuming and efficient. Also since it takes only a short part of the working memory, so one is able to do it easily.

EDUCATION

Year	Degree	Institue	CGPA/Percentage
2015-19	BTech CSE	Indian Institue of Technology, Kanpur	9.8
2015	12th | CBSE	Bal Bharati Public School Pitampura, Delhi	95.4%
2013	10th | CBSE	Bal Bharati Public School Pitampura, Delhi	10.0

References

[1] Sages and T. Brahma. *Atharvaveda.* India, 1200BC.

[2] B. K. Tirathji. vedic math academy.

[3] S. Wolfram. Wolfram alpha.