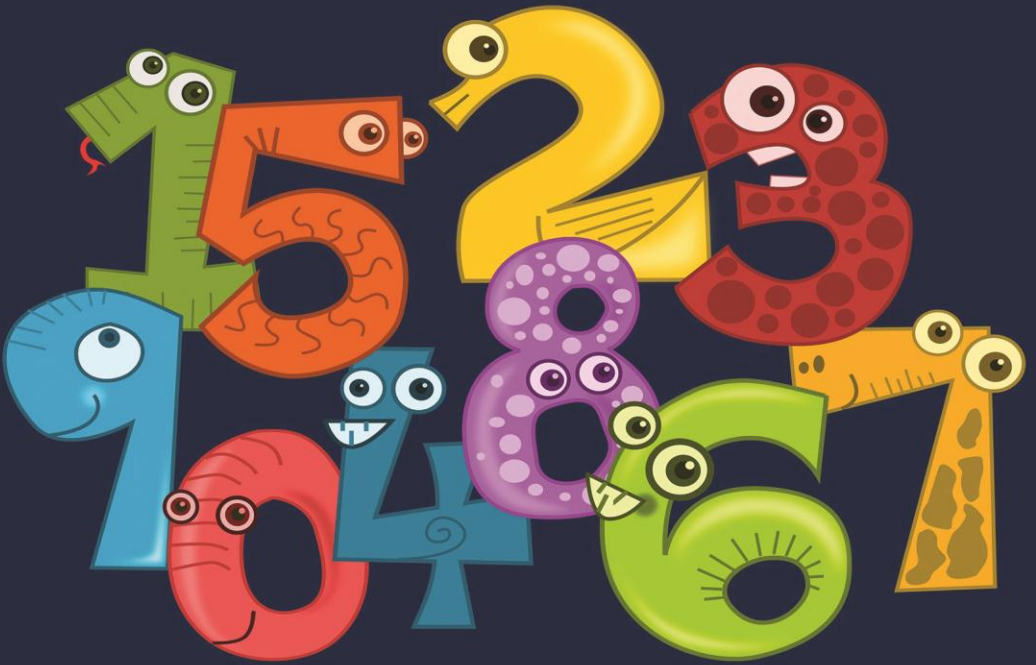


Bonded Number And High Speed Multiplication



Amarjit Singh Bhasin

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Publishing-in-support-of,

EDUCREATION PUBLISHING

RZ 94, Sector - 6, Dwarka, New Delhi - 110075
Shubham Vihar, Mangla, Bilaspur, Chhattisgarh - 495001

Website: *www.educreation.in*

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ISBN: 978-1-61813-500-1

Price: ₹ 215.00

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Printed in India

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By

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EDUCREATION PUBLISHING

(Since 2011)

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Foreword

Multiplication at computer speed.

Bonded numbers were found, while searching for a short cut to multiplication.

In bonded numbers, multiplication is reduced to addition. It is possible to multiply 100 digits of a bonded number with another number consisting of 100 digits in about 5 minutes in one straight line. This is demonstrated later in the text.

Presence of Bonds in bonded number helps in converting multiplication to addition. More important than huge multiplications in bonded numbers is the bond system. The same bond system is present in the product of the multiplication. Only the multiplicand is free of these bonds. Multiplication is done with the help of simple rules. The system has the in-built test of correctness of answer.

Bond system in bonded numbers can be compared to bonds in chemical action, where different elements combine to form compounds.

The book is being published in the hope that it will prove useful in understanding the essentials of numbers and multiplication.

- Amarjit Singh Bhasin



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Chapter I
Right Bonded Numbers



MULTIPLICATION BOND

Consider the following number

8 4 2 1

Do you find anything special in this number? Here each digit is double of its right hand digit, 2 is double of 1, 4 is double of 2, and 8 is double of 4.

This type of number is called Right Bonded Number. It is so called, because the number is bound from right hand side. In the example, the multiplication bond is equal to 2. Right bonded numbers can be extended to any number of digits as is explained later in the chapter.

It is very easy to multiply such type of numbers. In the first example multiplication is done with a bonded number of 4 digits. A little later we will multiply a bonded number consisting of 108 digits with another number also consisting of 108 digits. As you will see, the process in bonded number multiplication is so simple, that it is very easy to multiply a 100 digits bonded number with another number consisting of 100 digits.

Multiplication with Bonded Numbers

Only two digits of the bonded number take part in the multiplication. Extreme right hand digit and extreme left hand digit. The answer will come in two halves, the right hand half of the answer will come first and after that the left hand half of the answer will come.

- **First Rule**

Number R is obtained by multiplying the multiplicand and with the right hand figure of the bonded number.

- **Second Rule**

Number L is obtained by multiplying the multiplicand with the new number formed by extending the bonded number.

- **Third Rule**

Write L and R side by side, Put down the right hand digit of R as the right hand digit of the answer. Each resulting figure of the answer is multiplied by multiplication bond and to it is added the next left hand figure in the number R.

➤ **At the stage of L**

Each resulting figure of the answer is multiplied by multiplication bond and from it is subtracted the next left hand figure in the number L.

In the bonded system of multiplication, we write the answer from right to left, one figure at a time. Right hand half of the answer will appear under R and left hand half of the answer will appear under L. To help in the calculations, we write the carry at each step below the answer and line is drawn between the two. So the answer appears between the two lines, R and L are above the upper line while carry at each step appears below the lower line.

L	R
Left hand half of the answer will come here	Right hand half of the answer will come here
Carry will be written here	Carry will be written here
New let us do an actual multiplication.	
8 4 2 1 x	5 6 5 2
Bonded Number	Multiplicand

8 4 2 1 is the bonded number with multiplication bond equal to 2, as each digit is double of its right hand digit. 2 is double of 1, 4 is

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double of 2 and 8 is double of 4. Let us apply the rules. The asterisks will identify the numbers being used in each step of calculation.

- **First Rule**

Number R is obtained by multiplying the multiplicand with the right hand figure of the bonded number.

$$R = 5\ 6\ 5\ 2 \times 1 = 5\ 6\ 5\ 2$$

- **Second Rule**

Number L is obtained by multiplying the multiplicand with the new number formed by extending the bonded number.

$$\text{Multiplication bond} = 2$$

$$\text{Bonded Number} = 8\ 4\ 2\ 1$$

New number formed by extending the

$$\text{bonded number} = 8 \times 2 = 16$$

$$L = 5\ 6\ 5\ 2 \times 16 = 9\ 0,\ 4\ 3\ 2.$$

- **Third Rule**

Write L and R side by side. Put down the right hand digit of R as the right hand digit of the answer.

L					R					
9	0	4	3	2	5	6	5	2	*	
									2	

Each resulting figure of the answer is multiplied by multiplication bond and to it is added the next left hand figure in the number R.

Double 2 plus 5 is 9.

L					R			
9	0	4	3	2	5	6	5	2
					*			
					9 2			

Apply the rule again. Double 9 plus 6 is 24. Write 4 in the answer and carry 2.

L					R			
9	0	4	3	2	5	6	5	2
					*			
					4 9 2			
					2			

Apply the rule again. Double 4 plus 5 plus carry 2 is 15. Write 5 in the answer and carry 1.

L					R			
9	0	4	3	2	5	6	5	2
					*			
					5 4 9 2			
					*			
					1 2			

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➤ **At the stage of L**

Each resulting figure of the answer is multiplied by multiplication bond and from it is subtracted the next left hand figure in the number L.

Double 5 minus 2 plus carry 1 is 9.

L					R				
9	0	4	3	2	5	6	5	2	
					*				
					9	5	4	9	2
					*				
					1	2			

Apply the rule again. Double 9 minus 3 is 15. Write 5 in the answer and carry 1.

L					R					
9	0	4	3	2	5	6	5	2		
					*					
					5	9	5	4	9	2
					1	1	2			

Apply the rule again. Double 5 minus 4 plus carry 1 is 7.

L					R			
9	0	4	3	2	5	6	5	2
					*			

$$\begin{array}{r}
 * \\
 7 \quad 5 \quad 9 \quad 5 \quad 4 \quad 9 \quad 2 \\
 \hline
 * \\
 1 \quad 1 \quad 2
 \end{array}$$

Apply the rule again. Double 7 minus 0 is 14. Write 4 in the answer and carry 1.

$$\begin{array}{r}
 L \qquad \qquad \qquad R \\
 * \\
 9 \quad 0 \quad 4 \quad 3 \quad 2 \quad 5 \quad 6 \quad 5 \quad 2 \\
 \hline
 * \\
 4 \quad 7 \quad 5 \quad 9 \quad 5 \quad 4 \quad 9 \quad 2 \\
 \hline
 1 \quad 1 \quad 1 \quad 2
 \end{array}$$

Apply the rule again. Double 4 minus 9 plus carry 1 is 0.

$$\begin{array}{r}
 L \qquad \qquad \qquad R \\
 * \\
 9 \quad 0 \quad 4 \quad 3 \quad 2 \quad 5 \quad 6 \quad 5 \quad 2 \\
 \hline
 * \\
 4 \quad 7 \quad 5 \quad 9 \quad 5 \quad 4 \quad 9 \quad 2 \\
 \hline
 1 \quad 1 \quad 1 \quad 2
 \end{array}$$

So the answer of 8421×5652 is 47,595,492.

In the above example we have multiplied a bonded number of 4 digits with another number of 4 digits. The product can contain maximum 8 digits. The ninth digit 0 is the test of correctness of multiplication. The ninth digit at the left must be 0, otherwise the multiplication is wrong.

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This is the beauty of the system. It contains the in-built check of the multiplication.

➤ **Test of Correctness of the answer**

The extreme left hand digit of the answer when extended in the normal way must result in zero. Any further extension of the answer must also result in zero.

➤ **Concept of Minus Carry**

To clear our way for bigger multiplications, we must clear a hurdle. Sometimes, L may give a negative number as an answer. The digit subtracted may be the bigger one. The answer at each step must contain only single digit positive number. To meet this provision, we must convert negative number into positive number with the help of minus carry.

Rule

The negative number in the answer is changed to positive number by subtracting it from the immediate bigger number, which is a multiple of 10. The minus value of the bigger number, when divided by 10 will give us the value of carry, suppose the number in the answer is -17. The immediate bigger number which is a multiple of 10 is 20. $20 - 17 = 3$. Write 3 in the answer and carry = $-20 \div 10 = -2$. Or in other words -17 is written in the answer as

$\frac{3}{-2} (-2 \times 10 + 3 = -17)$. This is the test to know whether we have

put the minus carry correctly or not.

Let us illustrate with an example.

$$\frac{8421}{\text{BondedNumber}} \times \frac{3213}{\text{Multiplicand}}$$

Multiplication Bond = 2.

Let us apply the rules,

- **First Rule**

Number R is obtained by multiplying the multiplicand with the right hand figure of the bonded number.

$$R = 3213 \times 1 = 3213.$$

- **Second Rule**

Number L is obtained by multiplying the multiplicand with the new number formed by extending the bonded number.

$$\text{Bonded Number} = 8421$$

$$\text{Multiplication Bond} = 2$$

New number formed by extending the bonded number

$$= 8 \times 2 = 16.$$

$$L = 3213 \times 16 = 51,408.$$

- **Third Rule**

Write L and R side by side. Put down the right hand digit of R as the right hand digit of the answer.

L					R			
5	1	4	0	8	3	2	1	3
					*			
					3			

Each resulting figure of the answer is multiplied by multiplication bond and to it is added the next left hand figure in the number R. Double 3 plus 1 is 7.

L					R			
5	1	4	0	8	3	2	1	3
					*			
					3			

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$$\begin{array}{r} * \\ 7 \quad 3 \\ \hline \end{array}$$

Apply the rule again. Double 7 plus 2 is 16. Write 6 in the answer and carry 1.

L					R			
5	1	4	0	8	3	2	1	3
					*			
					6	7	3	
					1			

Apply the rule again. Double 6 plus 3 plus carry 1 is 16. Write 6 in the answer and carry 1.

L					R			
5	1	4	0	8	3	2	1	3
					*			
					6	6	7	3
					*			
					1	1		

➤ **At the stage of L**

Each resulting figure of the answer is multiplied by multiplication bond and from it is subtracted the next left hand figure in the number L. Double 6 minus 8 plus carry 1 is 5.

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