

# ***Abacus***

***Yimin***

***Zhang***

Dr. Hubert Bray

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## ***Introduction***

Abacus is a calculating tool that was invented before the written Hindu–Arabic numeral system spread all over the world. Although the computer has been widely used today, the ancient abacus is not only not abandoned, but because of its flexibility, accuracy and other advantages, it is still widely used in many countries. Moreover, the Chinese abacus was added to the World Intangible Cultural Heritage list by UNESCO, and it is considered as the fifth invention of the ancient China. In this paper, I will talk about how abacus works and its effect all over the world.

## ***Main Kinds of Abacus***

From the existing literature, many ancient civilizations have their own abacus-like calculating tools. All kinds of abacus can be divided into three categories: sand table, calculating board, and bead abacus.

1. Sand table is a flat table covered with sand. People with sticks write, draw and calculate on the sand table.
2. People stopped using sand gradually, instead, they engraved a number of parallel lines on a flat board, and placed some small stones to count and calculate.
3. Bead abacus refers to the Chinese abacus, the Japanese abacus and the Russian abacus. In the world of ancient abacus, the Chinese abacus is the most advanced abacus tools.

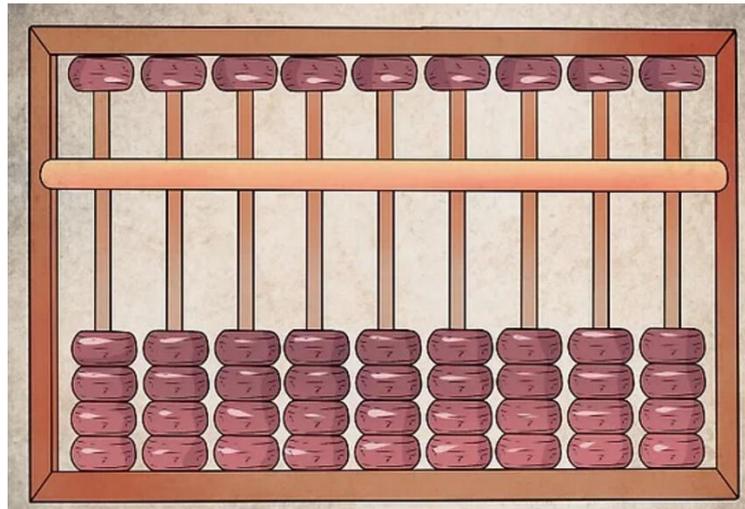
## ***How Japanese abacus works***

Among all kinds of abacus, Japanese abacus is the most widely used abacus. Many elementary schools even use Japanese abacus to teach children how to count. This is

a more efficient way to teach children than number cards. The Japanese abacus has two decks of beads equally distributed in different columns. In the top deck of each column, there is only one bead, and the bottom deck will have four beads.

### **1. basic counting rules**

Before calculation, all the beads must be returned to its starting position.



**The starting position**

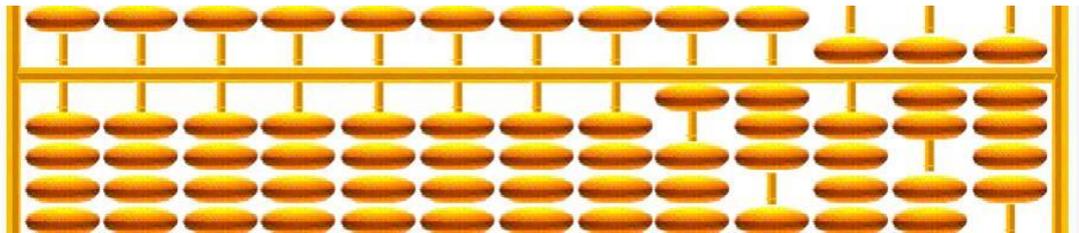
The bead in the upper deck represents the number 5, and the beads in bottom deck each represents the number 1.

(When a person is familiar with the calculating by abacus, a single bead may also represent five or even ten. However, the bead in the top deck is always 5 times bigger than a bead in bottom deck.)

Each column of beads represents a digital value. Therefore, the first column from the right should be ones, the second column is tens, and the third column is hundreds and so on. (You can also make the first column from the right tenth if needed.)

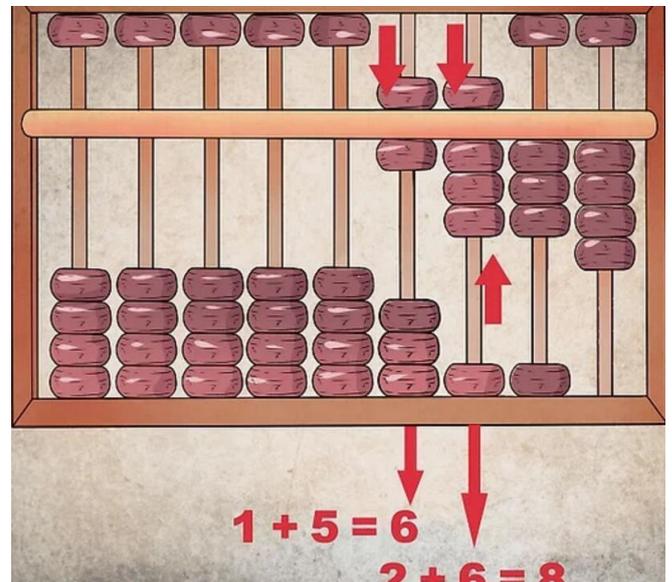
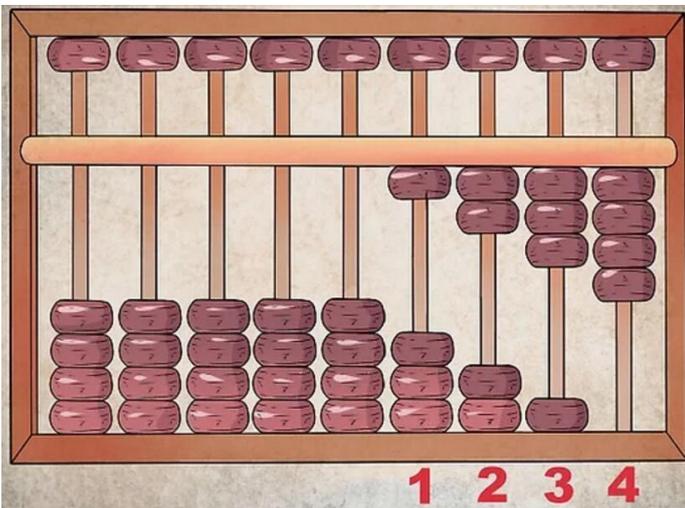
To represent a number by an abacus, beads from the bottom deck should

be pushed up, and by pushing each bead up, the number of the specific digital value increases one. When representing a number of a specific digital value is bigger than five, the bead in the top deck should be pushed down. Here is an example of the number 13579.



## 2. Addition and Subtraction

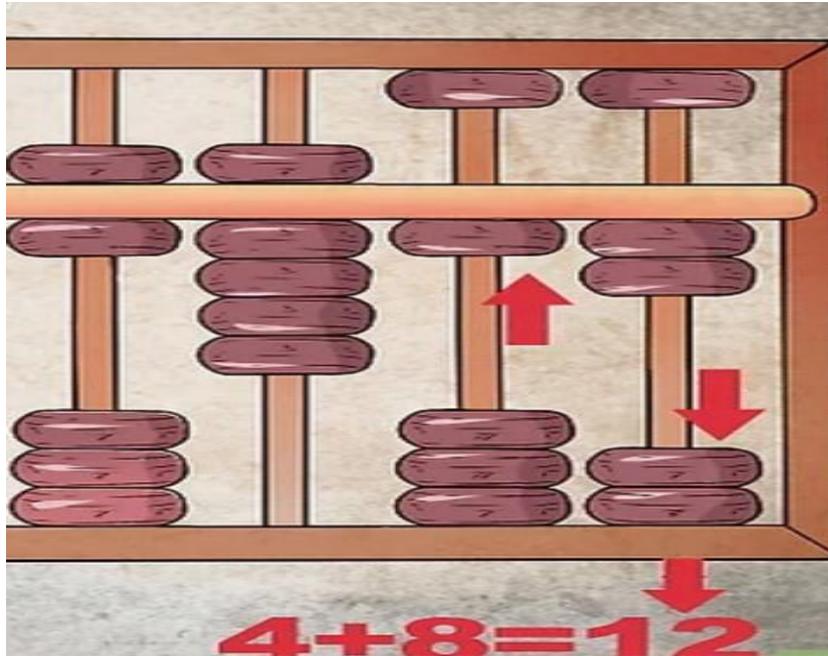
To add some numbers together, firstly, input the first number, and then add the number from left to right. It simply means, if the biggest number is 1234, then calculate the thousands first.



**An example of addition of the first left two digit values of 1234+5678**

When two digits add up to a number bigger than ten, subtract the sum by

ten and input the result on the column, and push one bead from the column on the left side up. Here is a figure that shows an example of it.



It is pretty much the same for subtraction. When doing the subtraction, it is impossible to subtract 6 from 3, so by returning one bead to its starting position on the left column, it makes 3 to 13, the answer for that column would be  $13-6=7$ .

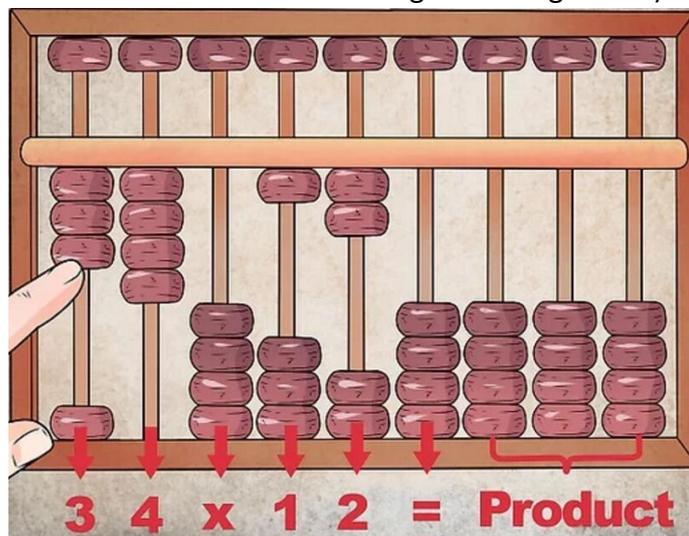
### 3. Multiplication

Before talking about multiplication on abacus, there is a required thing to remember not only to do the multiplication, but also division. It is the 9\*9 multiplication table.

×	1	2	3	4	5	6	7	8	9
1	1	2	3	4	5	6	7	8	9
2	2	4	6	8	10	12	14	16	18
3	3	6	9	12	15	18	21	24	27
4	4	8	12	16	20	24	28	32	36
5	5	10	15	20	25	30	35	40	45
6	6	12	18	24	30	36	42	48	54
7	7	14	21	28	35	42	49	56	63
8	8	16	24	32	40	48	56	64	72
9	9	18	27	36	45	54	63	72	81

Similar to addition and subtraction, multiplication calculates from the left side to the right.

Input the two numbers which are going to be multiplied, and leave a space between the two numbers which represents \*, and leave a space between the second number and the result which represents = (They are all by means to clarify the first number, second number and the result, so that we do not miss read these numbers and get a wrong result.).



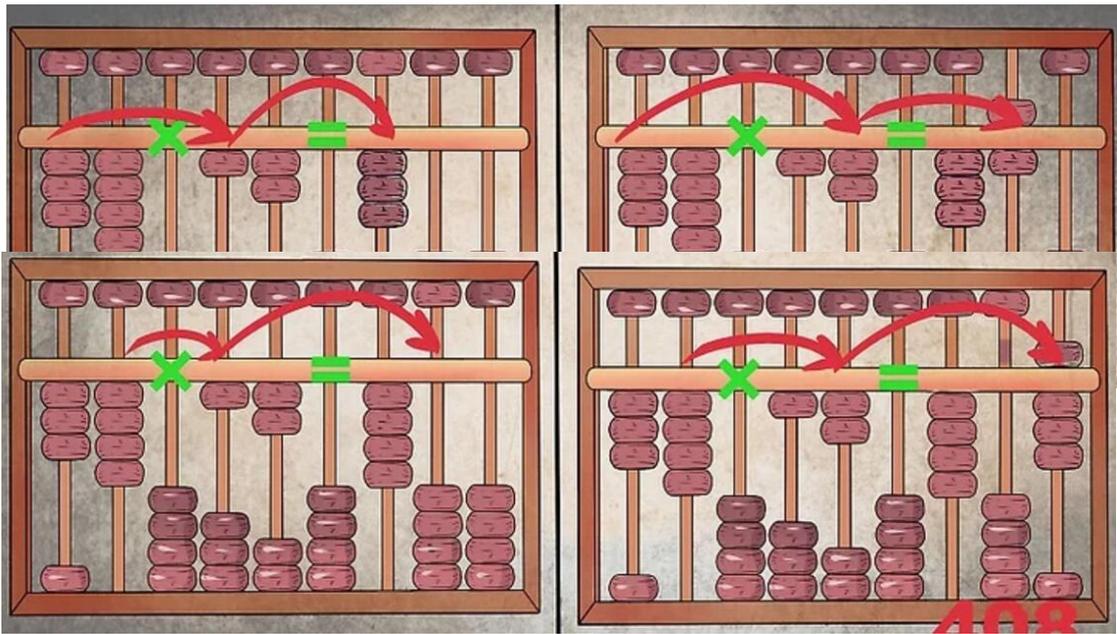
There are basically three steps to calculate the result of multiplication of a two-digit number to a two digit number:

- \* Multiply the first digit from the left of the first number to the first digit from the left of the second number, and that will be the left first digit of the result.
- \* Multiply the first digit from the left of the first number to the second digit from the left of the second number, and it equals x.
- \* Multiply the second digit from the left of the first number to the first digit from the left of the second number, and it equals y, so the second left digit of the result is x+ y.

\* Multiply the second digit from the left of the first number to the second digit from the left of the second number, and that will be the third left digit of the result.

(If the digit of the result is bigger than ten, then do as the same as addition.)

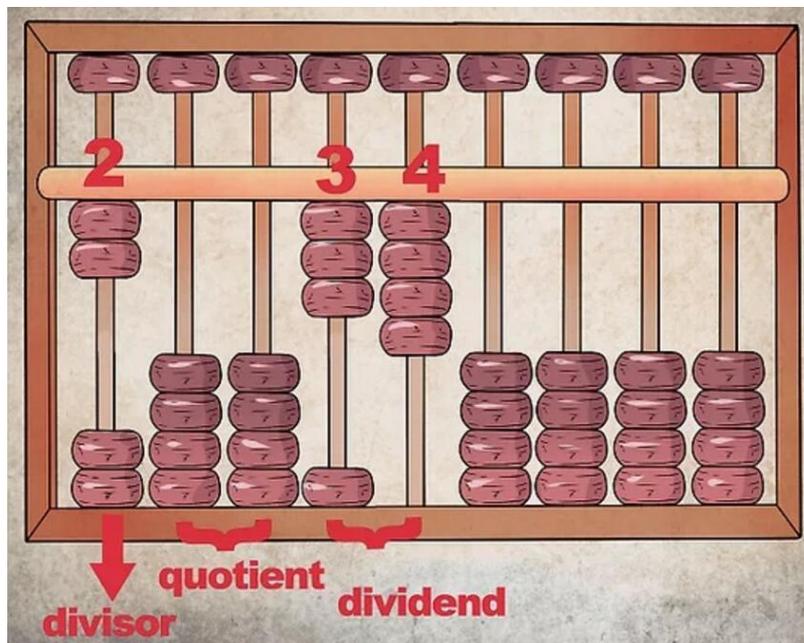
It is the same method for any x-digit number time x-digit number.



An example of how  $34 \times 12$  is calculated

#### 4. Division

Input the equation  $34/2$  as the figure below.





Column material can be wood, silver, copper, aluminum, bamboo and so on. The better the material, the higher the value of the collection.

(In addition, the value of the abacus can also be measured by quality and product phase.)

Second, the superior woody abacus. If the collection of wooden abacus' material is red sandalwood, mahogany or rosewood, the abacus will be worth collecting. The woody abacus will not be on the paint, because the woody abacus is worth for its natural color. Even after years of baptism, good wood will be more beautiful, and beads will be smooth. Only abacus made of the general wood material will be painted with heavy paint to cover the wooden mediocre. (Pear wood, pine, incense wood, cedar belong to medium material, hardwood belong to low-grade material.)

Third, abacus with peculiar shape worth gradually higher. Round, fan-shaped, arched, cylindrical, pagoda and other peculiar shape of the abacus, because of their sophisticated technology, appreciation value, they are usually loved by the collector. As the number of columns of abacus is usually odd, such as nine, eleven, thirteen, fifteen, 17 and so on, the abacus with even number of columns values even higher than the usual abacus. Small and exquisite pocket abacus and large abacus with 21 or more columns enrich the cultural connotation of abacus, so they also worth collecting.

### ***Conclude***

Abacus has made great contribution to the world. It helped the ancient technology developed a lot, and many significant scientific research could not have done without the help of the abacus. Although the world is filled with modern calculator and

computer, abacus still takes an important role. Abacus is not only used to calculate, but also a symbol of a country's culture.

## ***Reference***

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