

# WMW #2: The Vinculum Numbers (not from vedic mathematics)

We use parentheses (or brackets) to perform order of operations. What happened to the vinculum? (What is it anyway?)

Suppose:  $\overline{6+1}+7$ . It is same as writing with parenthesis:  $(6+1)+7$ .

The vinculi is widely used during the 15<sup>th</sup>, 16<sup>th</sup>, and 17<sup>th</sup> centuries. With vinculi, it is easier to determine the order of operations.

Example:

$$\overline{\overline{7+4}+2+\overline{8+1}} = ((7+4)+2+(8+1))$$

$$\overline{11+2+9} = (11+2+9)$$

Then add from left to right.

Example:

$$6 + \overline{\overline{3+8}+2+\overline{12+7}} = 6 + ((3+8)+(2+(12+7)))$$

$$6 + \overline{11+2+19} = 6 + (11+(2+19))$$

$$6 + \overline{11+21} = 6 + (11+21)$$

Then add 11+21.

For more complex expressions, use the vinculum.

$$\overline{\overline{6 \times 13 - 3 + 24 + 2 \times 9 + 7 + 5 + 20 \times \frac{1}{2}}}$$

Since the invention of the printing press in 1440, vinculi gradually became phased out in favor of parentheses.

How could we express  $2(a^2+b)$  with vinculi?

Answer:  $2 \times \overline{a^2+b}$ . (You will have to use the multiplication symbol in this case)

Vinculi and parentheses can be used together in one expression.

$$1 + (2 + ((7 + (((2 + ((2+3) + 1)) + 3) + 8)) + 3))$$

But the vinculum is still used today! How?!

It is the part of the radical...

$$\sqrt{c^2+4}$$

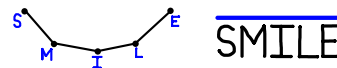
Labels: root/radix, vinculum

...and in repeating decimals...

$$0.\overline{9} = 1 \quad \overline{6.512}$$

Label: vinculi

...also used in naming points.



However, fractions do not use the vinculum.

Instead, they use the virgula:  $\frac{3}{5}$  ← Virgula

Math puzzle: Counting the vinculum numbers

Two terms, one way:  $\overline{a+b}$

Three terms, two ways:  $\overline{a+b+c}$ ,  $\overline{a+b+c}$

Four terms, five ways:  $\overline{a+b+c+d}$ ,  $\overline{a+b+c+d}$ ,  $\overline{a+b+c+d}$ ,  $\overline{a+b+c+d}$ ,  $\overline{a+b+c+d}$

The pattern continues with more terms.

Terms	Ways
5	14
6	42
7	132
8	429
9	1,430
10	4,862

This pattern is called: Catalan numbers.