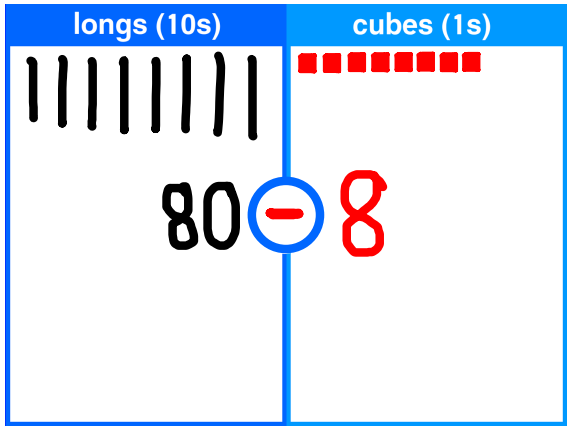
# WMW #2 - The Vinculum Numbers

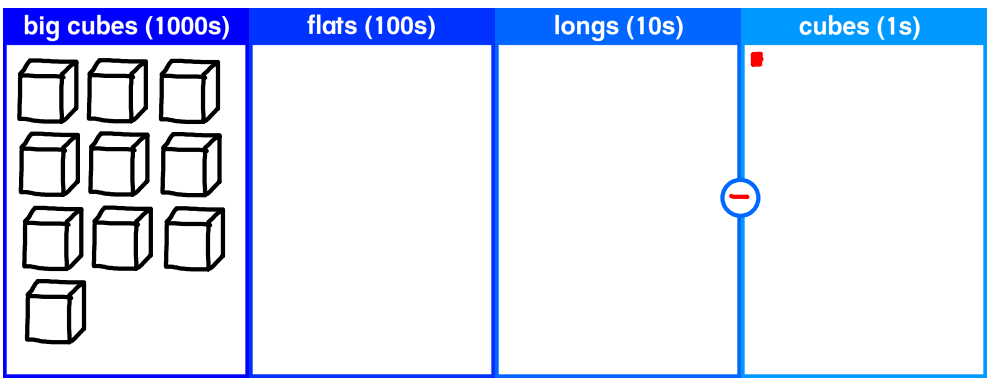
**Motivating Question:** Suppose you need to show 72 using base-10 blocks. However, you only have 10s and no 1s. **How can you model this number?**




In this case, we need to use 8 longs. However, since we want to model 72, we need something else that allows negative values. We have modeled 8 longs and $-8$ cubes. In other words, $72 = 8\overline{8}$, which is a **vinculum number**.

## There are some uses of vinculum numbers.

1) You have a number less than 10,000, but you still want to show "10 thousand" anyway. It is possible with vinculum numbers.




Examples:

$9{,}999 = 10{,}00\overline{1}$

$9{,}620 = 10{,}\overline{4}20$

$8{,}765 = 1\overline{2}{,}\overline{8}35$

$1 = \overline{19{,}999}$

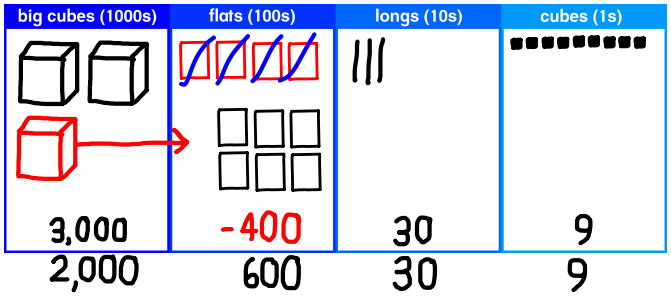
2) You want to subtract, but don't want to borrow. Yes! With vinculum numbers!

$$\begin{array}{r} 6{,}389 \\ -\,3{,}750 \\ \hline 3{,}\overline{4}39 \end{array}$$

If you want a regular number, then you need to borrow.

Convert $3{,}\overline{4}39$ to a regular number.

The regular number is **2,639**



# How can you show vinculum numbers in expanded form?

(and convert them into a regular number?)

Let's take $24,\overline{372}$ as an example.

$24,\overline{372}$

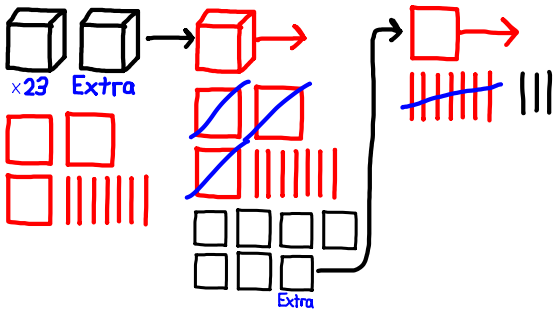
In expanded notation, it is going to be:

$20,000 + 4,000 - 300 - 70 + 2$

This means:

| | big cubes (1000s) | flats (100s) | longs (10s) | cubes (1s) |
|---|---|---|---|---|
| I have: | 24 | — | — | 2 |
| I owe: | — | 3 | 7 | — |

Then, convert $24,\overline{372}$ to a regular number.




$23,000 + 600 + 30$

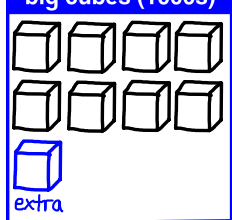
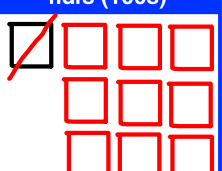
Therefore, the regular number is:

# 23,632

Coincidentally, this number is also a palindrome!

## Do you even want to convert regular numbers to vinculum? Yes! Here's how:

Let a number be 8,167. Model this number without using flats.

| | big cubes (1000s) | flats (100s) | longs (10s) | cubes (1s) |
|---|---|---|---|---|
| |   |  |  |  |
| Regular: | 8,000 | 100 | 60 | 7 |
| Vinculum: | 9,000 | -900 | 60 | 7 |

The vinculum number is $9,\overline{967}$.

You can always convert any regular number into vinculum.