WORKING WITH DECIMALS (contributed by Edvaldo Siqueira)

The following is a method used by Professor Fukutaro Kato, a Japanese soroban teacher living in Brazil in the 1960's. The method was published in the Professor's book, *SOROBAN pelo Método Moderno* which, when translated from Portuguese means *SOROBAN by the Modern Method*

This is an explanation on how to apply "Professor Kato's Method" for placing correctly the *multiplicand* or the *dividend* on the soroban, in order that the unit digit of the *product* or the *quotient* will fall always on a previously chosen unit column. Bear in mind that both arithmetic operations should be carried out according Kojima's standard methods for division & multiplication.

For the sake of clarity, let's split the following in 4 short sections: A) HOW TO COUNT DIGITS; B) NUMBERS ON THE SOROBAN; C) MULTIPLICATION D) DIVISION

A) COUNTING DIGITS

i) If the 2 pairs of numbers *multiplicand & multiplier* or *dividend & divisor* are mixed numbers (those with a whole part and decimal places), consider in each one only the digits in their whole part. So disregard any decimal digit, after the point, if any.

Ex:

```
3.105.....has 1 digit;
47.02.....has 2 digits
308.41.....has 3 digits
1000.......has 4 digits and so on
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ii) When the number is a pure decimal, consider (count) only those trailing zeros (if any) before the first significant digit attributing to the total a negative sign. Disregard the zero before the point

Ex:

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0.00084.....has -3 digits
0.40087.....has  0 digits
0.01010.....has -1 digit
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B) NUMBERS ON THE SOROBAN

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<----A----B----C----D----E---*F*---G----H----I----J-->
<...+6...+5...+4...+3...+2...+1....0...-1...-2...-3..>
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Let's associate an orientating axis extending from right to left of the soroban rods, with the axis positive number 1 corresponding to the *unit rod* (*F*). That correspondence is paramount to the correct application of this method! Obviously, the rod chosen to be carry the unit can be anyone - towards the center of the soroban - provided it is marked with a dot. To the left of *F* (rods E, D, C ...) we have positive values; to its right, Zero and negative values, as shown. Imagine the above diagram extending to both sides as far as necessary to work comfortably according Kojima's. You will soon note that when the absolute value of N "large" (say, > 4), the other printed dots on the bar are handy in choosing the appropriate rod for setting the multiplicand highest order digit.

MULTIPLICATION

a) *RULES TO FOLLOW*

Compute the Number: N = # digits on multiplicand + # digits on multiplier + 1

Note: Before computing N, please note that number 1 should always be added to the # of digits on the multiplier.

b) *EXAMPLES*

```
30 x 8.............N = 2 + 1 + 1 = 4
2 x 3.14...........N = 1 + 1 + 1 = 3
12 x 0.75..........N = 2 + 0 + 1 = 3
0.97 x 0.1.........N = 0 + 0 + 1 = 1
0.5 x 8.14.........N = 0 + 1 + 1 = 2
0.03 x 0.001.......N = -1 + (-2) + 1 = -2
```

c) *SOME SAMPLE QUESTIONS*

```
<----A----B----C----D----E---*F*---G----H----I----J-->
<...+6...+5...+4...+3...+2...+1....0...-1...-2...-3..>
```

i) 40.0 x 0.225 = 9,
N = 2 + 0 + 1 = 3 ----> set 4 on D...product 9 will fall on *F*

ii) 75 x 12 = 900
N = 2 + 2 + 1 = 5 ----> set 75 on BC...After the multiplication process is carried out, you'll be left with only a 9 placed on rod D; but as *F* carries always the unit result digit, the product must be automatically read: 900.

iii) 0.400 x 0.025 = 0.010
N = 0 + (-1) +1 = 0 ----> set 4 on G...(From the product = 0.01, you only see of course the number 1 on rod H, which should be read as 0.01 - because 0 (= the unit), is as always located on *F*.

iv) 2.6 x 3.5 = 9.1
N = 1 + 1 + 1 =3 ----> set 26 on DE...(product 91 will fall on FG; read as 9.1).

With practice, one will be able to compute N mentally and soon you should be using this alternative method correctly and confidently. The bonus is at the same time you will learn how to multiply decimal numbers on the soroban.

Quiz: From the "Examples" section above), choose the soroban appropriate rod to place the highest order digit of the multiplicand; do again each exercise after computing mentally its expression for N; eventually do on your soroban each multiplication suggested.

DIVISION

a) *RULES TO FOLLOW*

Compute the Number: N = # digits on dividend MINUS [# digits on divisor + 1]

Note: Before computing N, please note that number 1 should always be added to the # of digits on the divisor and also always remember that the operation between parenthesis must me carried out FIRST. If you need to, refresh your memory revisiting that old math book that taught you how to algebraically add negative numbers, many years ago. Or ask your son for advice. **:)** That is the burden of this method, I admit.

*****Further rules for placing the quotient digit (never FORGET THIS ALSO)*****

ai) If the digit of the dividend is *greater or equal* to the corresponding digit of the divisor, *skip one rod* to the left of the of this class of the dividend to put the corresponding quotient digit;

aii) If the digit of the dividend is *less than* the corresponding digit of the divisor, put the quotient digit *next to* the highest class you are working on the dividend.

b) *EXAMPLES*

```
32 ÷ 8.............N = 2 - (1 + 1) = 0
5 ÷ .25........... N = 1 - (0 + 1) = 0
6.28 ÷ 2...........N = 1 - (1 + 1) = -1
12 ÷ 0.75..........N = 2 - (0 + 1) = 1
3.2 ÷ 0.0016.......N = 1 - (-2 + 1) = 2
0.03 ÷ 0.001.......N = -1 - (-2 + 1 = 0
```

c) *SOME SAMPLE QUESTIONS*

```
<----A----B----C----D----E---*F*---G----H----I----J-->
<...+6...+5...+4...+3...+2...+1....0...-1...-2...-3..>
```

i) 625 ÷ 5 = 125
N = 3 - [1 + 1] = 1 ----> set the dividend (625) on FGH and place the quotient on DEF, (rule ai). The "5" from the quotient will automatically be placed on rod *F* (the unit).

ii) 0,02 ÷ 0.8 = 0.025
N = -1 - [-0 + 1] = -2 ----> set dividend (2) on I and place the quotient digits (25) on HI, (rule aii). As *F* - which always holds the unit (0.) - and G are both empty, one should automatically read 0.025.

iii) 0.08 ÷ 0.002 = 40
N = -1 - [-2 + 1] = -1 - [-1] = -1 +1 = 0 ----> set dividend (8) (disregard the zeros) on G and the calculated quotient 40 on EF (rule ai) - only its digit 4 will be set, but result reads 40.

iv) 86 ÷ 43 = 2
(Mentally) N = -1 ----> set dividend 86 on HI. As first digit of the dividend (8) is greater than first digit of the divisor (4), their quotient will skip one column to the left of this digit of the dividend to place the digit for the quotient. "8 / 4 = 2, which will be set at *F*, (rule ai).

v) 860 ÷ 43 = 20
(Mentally) N = 0 ----> set dividend 860 on GHI. the quotient 2 should be set at E. The soroban operator will interpret this result as 20, because rod F* always carries the unit.

Note: Take some time to compare the quotients digits on the last two examples. One sees for both only number 2. BUT they are placed at DIFFERENT rods. The former is at the very unit rod *F*. The latter is at E and has a unit digit after it, the 0 on rod *F*. So, even without evaluating beforehand their order or magnitude, the student is able to reach the correct answer for each example.

Below find 3 links to pages that have been scanned from Fukutaro Kato's book. These pages will further illustrate how to place correctly the *dividend & quotient digit* on the soroban using the method.

- **Page 1**
- **Page 2**
- **Page 3**

With practice, one will be able to compute N mentally and soon you should be using these alternative methods correctly and confidently. The bonus is at the same time you will learn how to multiply and divide decimal numbers on the soroban.

And a final advice: as you have observed Fukutaro Kato's method allows one to reach the exact result without having to evaluate beforehand the product and quotient order of magnitude, while operating both with integers or decimal numbers! But, if you are already familiar with other system, please stick to it. I am not advocating the one here exposed is better to any other. All I can say that, at least for me, I found it easier to grasp than the other one taught by Kojima, which I never learned :)

Good luck! Edvaldo Siqueira, Rio de Janeiro, Brazil