

252 101-01 2-21-23

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• mid 2: TH of next week.

• pas: ext. 1 last day

Pa6 stuff

integer consists of

Sign: $+1, -1, 0$

magnitude: $[, , , , , ,]$

Ex. Addition $b=100, p=2$

$$\begin{array}{r} 1 \quad 1 \quad 1 \\ (88 \ 21 \ 33) = 882,133 \end{array}$$

$$(65 \ 91 \ 79) = 659,179$$

$$(01 \ 54 \ 13 \ 12) = 1,541,312$$

Another way:

$$(88 \ 21 \ 33)$$

$$(65 \ 91 \ 79)$$

$$\begin{array}{r} +1 \quad +1 \quad +1 \\ (153 \ 112 \ 112) \text{ vector sum} \end{array}$$

$$-100 \ -100 \ -100$$

$$(01 \ 54 \ 13 \ 12) \text{ normalize}$$

Ex Subtraction. $b=100, p=2$

$$\begin{array}{r} -1 \quad -1 \\ (88 \quad 21 \quad 33) \end{array}$$

$$(65 \quad 91 \quad 79)$$

Ans $(22 \quad 29 \quad 54)$

another way

$$(88 \quad 21 \quad 33)$$

$$(65 \quad 91 \quad 79)$$

$$\begin{array}{r} -1 \quad -1 \\ (23 \quad -70 \quad -46) \end{array} \text{ vector diff.}$$

$$100 \quad 100$$

$$(22 \quad 29 \quad 54) \text{ normalize}$$

Ex. Subtraction $b=100$, $P=2$

$$\begin{array}{r} 65 \ 91 \ 79 \\ 88 \ 21 \ 33 \\ \hline \end{array}$$

$(-23 \ 70 \ 46)$ vector diff.

↑
negative leftmost digit

$$\boxed{-1} \begin{pmatrix} -1 & -1 & \\ 23 & -70 & -46 \end{pmatrix}$$

100 100

$$\boxed{-1} \ (22 \ 29 \ 54) \text{ normalize}$$

↑
helper for normalize
should return sign.

Ex no-normalize only $b=10, P=1$ LS

$$\begin{pmatrix} -9 & +1 & +6 & -5 & -50 \\ 1 & -90 & 9 & 73 & 0 & -500 \end{pmatrix}$$

$$-89 \quad 15 \quad 68$$

$$90 \quad -10 \quad -60 \quad +50 \quad +500$$

$$\begin{pmatrix} -8 & 1 & 5 & 8 & 0 & 0 \end{pmatrix} \text{ normalize}$$

$$\boxed{-1} \begin{pmatrix} -1 & -1 & -1 & 0 & 0 & 0 \\ 8 & -1 & -5 & -8 & 0 & 0 \\ -2 & -6 & & & & \end{pmatrix} \text{ normalize again}$$

$$\boxed{-1} \begin{pmatrix} 10 & 10 & 10 \\ 7 & 8 & 4 & 2 & 0 & 0 \end{pmatrix}$$

↑
returned by normalize

Ex. multiplication . $b=10, p=1$

$$\begin{array}{r}
 \begin{array}{r}
 11 \\
 123 \\
 \times 456 \\
 \hline
 738 \\
 6150 \\
 49200 \\
 \hline
 56088 \checkmark
 \end{array}
 \end{array}$$

$(1 \quad 2 \quad 3)$ $\swarrow$ n digits
 $(4 \quad 5 \quad 6)$ $\swarrow$ m digits

$(6 \quad 12 \quad 18)$	scalar mult.	0
$(7 \quad 3 \quad 8)$	normalize	
$(5 \quad 10 \quad 15 \quad 0)$	s.m.	1
$(5 \quad 17 \quad 18 \quad 8)$	add	

Shift

(6 8 8 8) no-normalize

□

(4 8 12 0 0) s.m.

2

(4 14 20 8 8) add

(5 6 0 8 8) normalize

Routine: $\oplus (m \cdot n)$

more detailed analysis

digit multiplications = $m \cdot n$

digit additions = $2mn + m^2$

Zero state for BigInteger

sign : 0

magnitude : [] empty list.