

CSE 101-02

5-10-22

- Midterm 2: Thur. 5/19
- Pa5: due tonight
- Pa6: examples

Ex.

(65 91 79)

(88 21 33)

-1

-23 70 46

100

-1

77 70 46

subtraction

vector diff.

normalize

sign

-1

-1 -1 -1 0
1 -77 -70 -46

100 100 100

~~(-1 22 29 54)~~

normalize

Pull out sign and no-normalize
if leftmost digit is negative

	-23	70	46	vector-diff
Sign	-1	-1	0	
-1	23	-70	-46	
		100	100	

(22 29 54) no-normalize

note: these helper funcs operate
on Lists, not BigIntegers, so
there's no need for them to be
members of BigInteger.

Ex Multiplication : $b = 10$

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

$$\begin{array}{r}
 (1 \ 2 \ 3) \quad \swarrow n \text{ digits} \\
 (4 \ 5 \ 6) \quad \swarrow m \text{ digits} \\
 \hline
 \end{array}$$

shift

6	12	18	scalar mult	0		
7	3	8	normalize			
5	10	15	0	scalar mult	1	
5	17	18	8	add		
6	8	8	8	normalize		
4	8	12	0	0	scalar mult	2
4	14	20	8	8	add	
(5	6	0	8	8)	normalize	

$$\begin{aligned} \text{Runtime} &= (\# \text{ digits in } 1^{\text{st}}) \cdot (\# \text{ digits in } 2^{\text{nd}}) \\ &= m \cdot n = \mathcal{O}(m \cdot n) \end{aligned}$$

more detailed:

$$(\# \text{ digit multiplications}) = m \cdot n$$

$$(\# \text{ digit additions}) = 2mn + m^2$$

Ex: $999 \times 999 = 998001$

again $b=10$

(9 9 9)

(9 9 9)

Shift

Prod =

() empty list

81 81 81

S.M.

0

81 81 81

add

8 9 9 1

norm

81 81 81 0

S.M.

1

89 90 90 1

add

9 8 9 0 1

norm

81 81 81 0 0

S.M.

2

90 89 90 0 1

add

(9 9 8 0 0 1)

normalize

note: intermediate calculations

did not exceed $100 = 10^2$

in general, they will not exceed b^2

Exercise:

show that in base b :

$$\underbrace{(b-1, b-1, b-1, \dots, b-1)}_n^2$$

$$= (\underbrace{b-1, \dots, b-1}_{n-1}, b-2, \underbrace{0, \dots, 0}_{n-1}, 1)$$

$$\boxed{b=10}$$

Ex. no-normalize (1, -90, 9, 73, 0, -500)

$$\begin{array}{cccccc} -9 & 1 & 6 & -5 & -50 & 0 \\ (1 & -90 & 9 & 73 & 0 & -500) \end{array}$$

$$-89 \quad 15 \quad 68 \quad -50$$

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

$$(-8 \quad 1 \quad 5 \quad 8 \quad 0 \quad 0)$$

$$\boxed{-1} \quad \begin{array}{cccccc} -1 & -1 & -1 & 0 & 0 & 0 \\ (8 & -1 & -5 & -8 & 0 & 0) \\ -2 & -6 & & & & \end{array}$$

$$10 \quad 10 \quad 10$$

$$\boxed{-1} \quad (7 \quad 8 \quad 4 \quad 2 \quad 0 \quad 0)$$

check:

$$1 \cdot 10^5 + (-90) \cdot 10^4 + 9 \cdot 10^3 + 73 \cdot 10^2 + 0 \cdot 10^1 + (-500) \cdot 10^0$$

$$= -784,200.$$

Lab: question

constructor from string

should handle:

" + 1 2 3 "

" - 1 2 3 "

" 1 2 3 "

" 0 "

" + 0 "

" - 0 "

Ex. $b = 100, p = 2$

" 1 | 2 3 " $\rightarrow (01, \underset{\uparrow}{2}3)$

" 1 | 2 3 | 4 5 | 6 7 " $\rightarrow (01, 23, 45, 67)$

incl:

$\begin{array}{cccc} \uparrow & \uparrow & \uparrow & \uparrow \\ 0 & 1 & 3 & 5 \end{array}$