

Pa4: BigInteger class

fields: int: signum (-1, 0, +1)

List: digits (from Pa4)

↑
List of longs.

zero state: sign = 0

digits = ()

Base b positional number sys.

$$(N)_b = a_{n-1} b^{n-1} + a_{n-2} b^{n-2} + \dots + a_1 b^1 + a_0$$

$$= [a_{n-1}, a_{n-2}, \dots, a_1, a_0]_b$$

↑ ↑ ↑ ↑
 // // // //

base b digits: $0 \leq a_i < b$

choose b to be 10^p for some
 $1 \leq p \leq q$.

Arithmetic in this representation:

Ex.

$$\begin{array}{r}
 \begin{array}{ccccc}
 & & 1 & & 1 \\
 (35 & 57 & 97) \\
 + & (14 & 90 & 82) \\
 \hline
 50 & 48 & 79
 \end{array}
 &
 \begin{array}{r}
 357797 \\
 149082 \\
 \hline
 504879
 \end{array}
 \end{array}$$

$$\begin{array}{r}
 \begin{array}{ccccc}
 & & -1 & & \\
 (35 & 57 & 97) \\
 - & (14 & 90 & 82) \\
 \hline
 20 & 67 & 15
 \end{array}
 &
 \begin{array}{r}
 357797 \\
 - 149082 \\
 \hline
 206715
 \end{array}
 \end{array}$$

Ex. vector + and -
then normalize.

add

$$\begin{array}{r}
 (35 \quad 57 \quad 97) \\
 + (14 \quad 90 \quad 82) \\
 \hline
 \begin{array}{ccc}
 1 & 1 & 0 \\
 (49 & 147 & 179) \\
 & 148 & \\
 & -100 & -100
 \end{array} \\
 \\
 (50 \quad 48 \quad 79)
 \end{array}$$

sub

$$\begin{array}{r}
 (35 \quad 57 \quad 97) \\
 - (14 \quad 90 \quad 82) \\
 \hline
 \begin{array}{ccc}
 -1 & 0 & 0 \\
 (21 & -33 & 15) \\
 & 100 &
 \end{array} \\
 \\
 (20 \quad 67 \quad 15)
 \end{array}$$

Advice: write fun

int normalizeList (List L);

Ex. (~~35~~ 57 97)

(64 90 82)

$\begin{matrix} -1 & 0 & 0 \\ (-29 & -33 & 15) \end{matrix}$

-30 100

(-30 67 15)

$\begin{matrix} -1 & -1 & 0 \\ (-1) \quad (30 & -67 & -15) \\ & -68 & \\ & 100 & 100 \end{matrix}$

← normalize

$\begin{matrix} (-1) \quad (29 & 32 & 85) \end{matrix}$

← normalize again.

Advice: write func in order

- constructor
- copy constructor
- from string constructor ↙ see string std library
- to-string()
- easy func: sign, make zero, negate
- hard func: compare, add, sub, mult
- overload operators:
 - ◀ insert into stream
 - comp: $<, <=, >, >=, ==$
 - arith: $+, +=, -, -=, *, *=$

Advice: (, , ,)

↗
back
most sig. digit

list of
longs

↖
front
least sig. digit

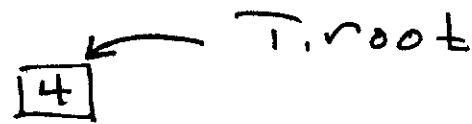
BST : insertion & deletion

Ex. Keys: 4, 1, 7, 2, 8, 3, 5, 6

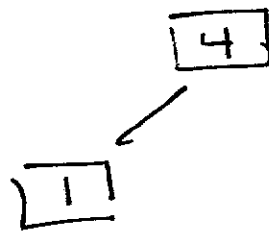
insert into initially empty tree

T.root = nil (empty state)

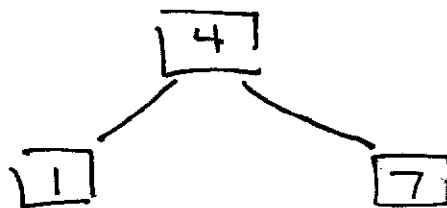
insert(4)



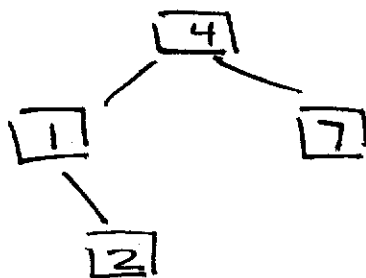
insert(1)



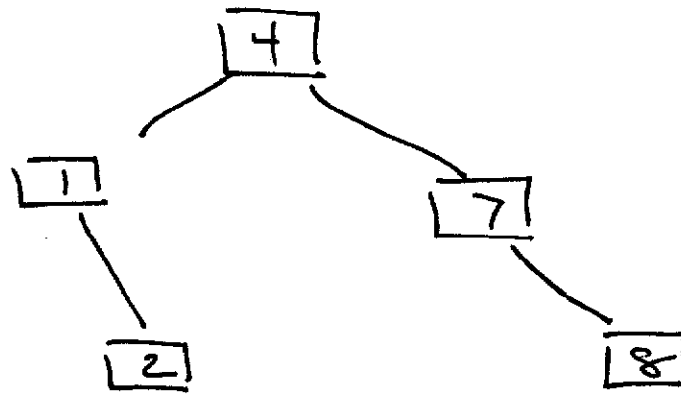
insert(7)



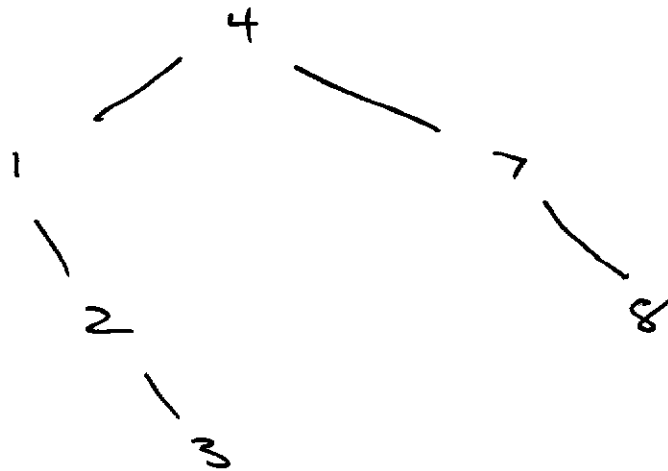
insert(2)



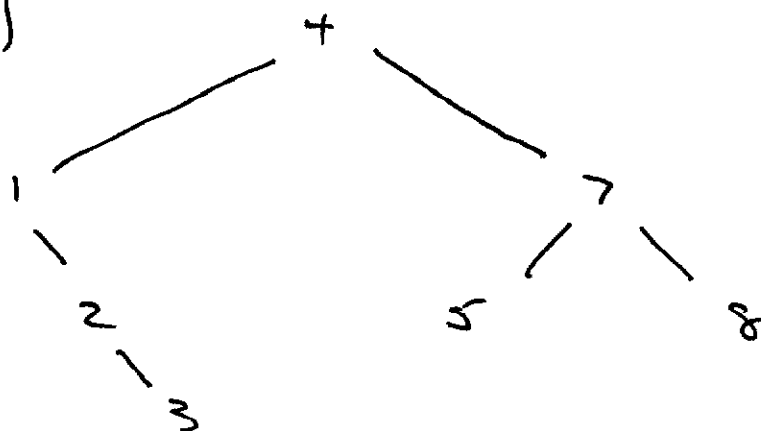
insert(8)



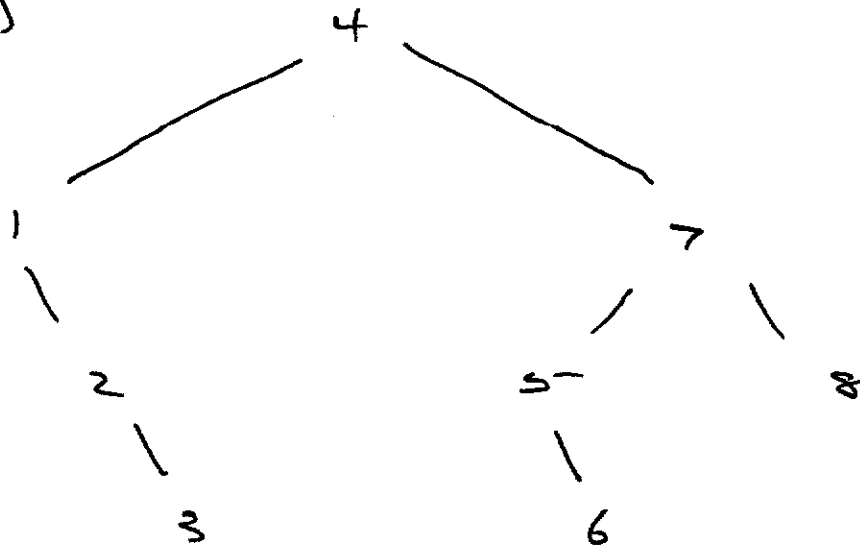
insert(3)



insert(5)



insert(6)



Runtime: $\Theta(\text{height}(T))$

next time:

- Transplant
- Delete

Pass : using const. from str.

`BigInteger A = BigInteger("257146");`

or

`std::string s1 = " " "`

`... s2 = " "`

`BigInteger B = BigInteger(s1);`

`BigInteger C = 123458897;`

`BigInteger D = "123458897";`

→ won't work.