3 Lecture #3: Values and Containers

mally due at midnight Friday. Last week's is due tonight.

ple classes. Scheme-like lists. Destructive vs. non-
perations. Models of memory.

Recreation

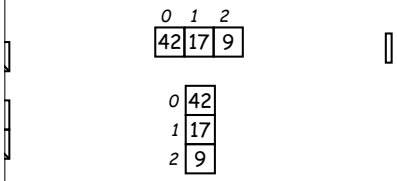
hat $\lfloor (2+\sqrt{3})^n \rfloor$ is odd for all integer $n \geq 0$.

larsky, N. N. Chentzov, I. M. Yaglom, *The USSR Olympiad Problem*
93), from the W. H. Freeman edition, 1962.]

Structured Containers

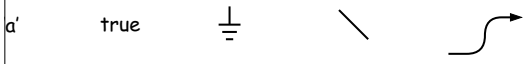
tainers contain (0 or more) other containers:

ject *Array Object* *Empty Object*



Values and Containers

umbers, booleans, and pointers. Values never change.



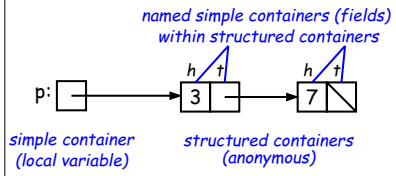
iners contain values:

riables, fields, individual array elements, parameters.

Containers in Java

ay be *named* or *anonymous*.

simple containers are named, *all* structured contain-
ymous, and pointers point only to structured containers.
structured containers contain only simple containers).



gnment copies values into simple containers.

Scheme and Python!

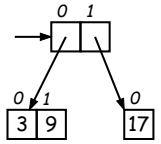
has slice assignment, as in `x[3:7]=...`, which is short-
ething else entirely.)

Pointers

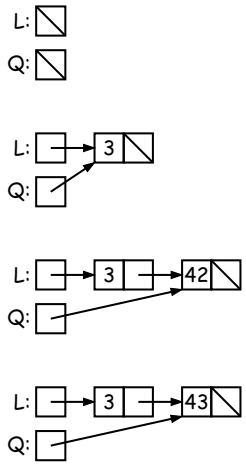
references) are values that *reference* (point to) con-

ar pointer, called **null**, points to nothing.

uctured containers contain only simple containers, but
w us to build arbitrarily big or complex structures any-



Primitive Operations




```
st(3, null);
st(42, null);
= 1;
== 43
head == 43
```


Defining New Types of Object

ations introduce new types of objects.

of integers:

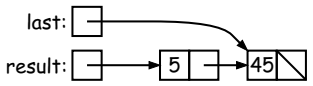
```
s IntList {
uctor function (used to initialize new object)
cell containing (HEAD, TAIL). */
tList(int head, IntList tail) {
ad = head; this.tail = tail;

of simple containers (fields)
G: public instance variables usually bad style!
t head;
tList tail;
```

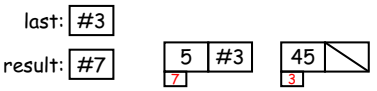

Another Way to View Pointers (II)

pointer to a variable looks just like assigning an integer

ecuting "last = last.tail;" we have



view:



native view, you might be less inclined to think that as- uld change object #7 itself, rather than just "last".

nternally, pointers really are just numbers, but Java as more than that: they have *types*, and you can't just ers into pointers.

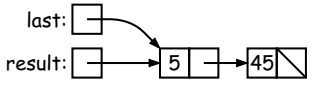
Recursion: Another Way to View Pointers

find the idea of "copying an arrow" somewhat odd.

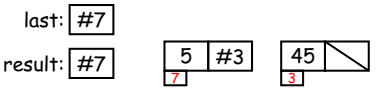
view: think of a pointer as a *label*, like a street address.

has a permanent label on it, like the address plaque on

ble containing a pointer is like a scrap of paper with a ss written on it.



view:



Nondestructive IncrList: Recursive

```
f all items in P incremented by n. */
List incrList(IntList P, int n) {
 null)
 null;
urn new IntList(P.head+n, incrList(P.tail, n));
```

crList have to return its result, rather than just set-

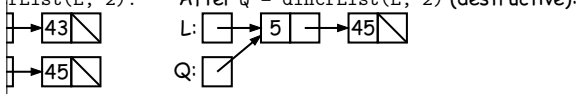
crList(P, 2), where P contains 3 and 43, which IntList created first?

Destructive vs. Non-destructive

n a (pointer to a) list of integers, L, and an integer in- rn a list created by incrementing all elements of the list

```
f all items in P incremented by n. Does not modify
ng IntLists. */
List incrList(IntList P, int n) {
 /*( P, with each element incremented by n )*/
```

t is *non-destructive*, because it leaves the input objects nown on the left. A *destructive* method may modify the o that the original data is no longer available, as shown



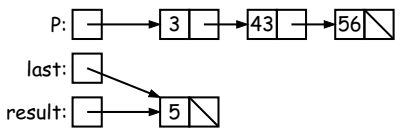
An Iterative Version

crList is tricky, because it is *not* tail recursive.
things first-to-last, unlike recursive version:

```
ncrList(IntList P, int n) {

, last;
      <<<
st(P.head+n, null);
!= null) {


ist(P.head+n, null);
tail;
```



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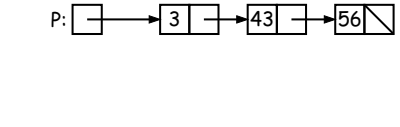

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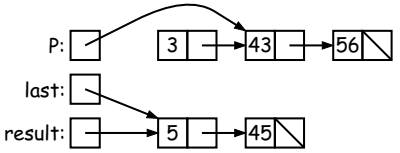

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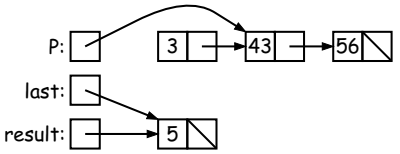

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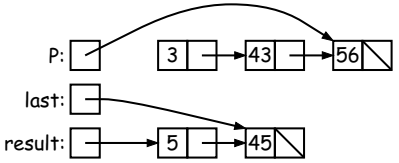

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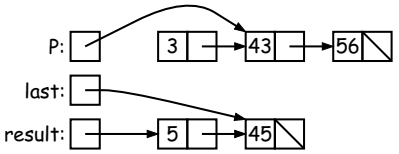

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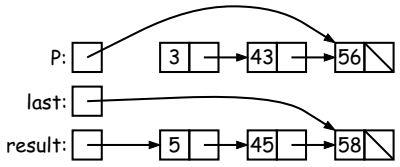

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