

## Lists, insertion sort

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NOTE this material also in `sorting_intro`

Recap lists: basic functions

Recap lists: experimenting with lists

## Sorting

- ▶ Sorting is the process of putting a collection of objects in a certain order
  - ▶ e.g. I mark exam scripts, and then order them by user id (email address)
- ▶ Sorting is an incredibly important bit of computer science
- ▶ Also relevant to everyday life
- ▶ We are going to look at some sorting algorithms on lists...
- ▶ We will also have to do a bit more recursion, because more advanced sorting algorithms are most naturally expressed using recursion

## List insert

```
List insert(int i, List l) {
    List to_return = nil();
    while(true) {
        if(l.isEmpty()) return append1(to_return,i);
        Integer j = (Integer)(hd(l));
        if(i < j.intValue()) {
            to_return=append1(to_return,i); // insert i here
            to_return=append(to_return,l); // don't forget the
            return to_return;
        }
        // i >= hd(l)
        to_return=append1(to_return,j);
        l=tl(l);
    }
}
```

## List insert

How would we write the following? insert takes an int i, and a list l0 (which is a list of integers, sorted in order) and inserts an Integer (with the same value as i) into the list at the right point (so the list still remains sorted).

```
List insert(int i, List l0) {
    ...
}
```

## Side note: ints and Integers

- ▶ ints are different from Integers; int is a primitive type; Integer is a class
- ▶ Lists hold objects (which have a class) not ints (which don't have a class)
- ▶ Java sometimes converts ints to Integers and Integers to ints to make things easy for you

## List insert

```
int i = 1;
Integer i0 = new Integer(1);

tmp1=cons(1,cons(2,cons(4,cons(5,nil()))));

insert(3,tmp1);

insert(3,nil());
```

## List insert

```
// how does this execute?
insert(3,[1,2,4,5]) -> [1,2,3,4,5]
```

to_return	i	l
[]	3	[1,2,4,5]
[1]	3	[2,4,5]
[1,2]	3	[4,5]
[1,2,3,4,5]		

## Sorting a list

```
// sorting a list of ints!
List sort(List l) {
    List to_return = nil();
    while(true) {
        if(l.isEmpty()) return to_return;
        to_return = insert(hd(l),to_return);
        l=tl(l);
    }
}

sort(cons(9,cons(3,cons(1,nil())))); // returns [1,3,9] as
```