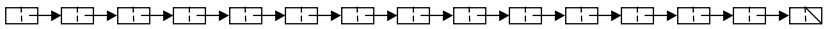
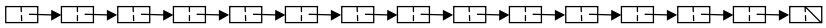


CSE 373: Lists

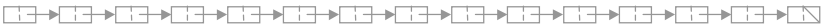
Chapter 3



What is a List?

List:

List Components



- Lists are composed of
  - *values*
    - of arbitrary, but fixed type (`Object`)
  - at *positions*
    - some notion of placement/order within a list
    - type not necessarily known by user (`ListItr<Object>`)
    - type depends on implementation

List Operations

Iteration operations (`List` methods):

```
ListItr<Object> first();
ListItr<Object> kth(int);
ListItr<Object> last();
```

Iteration operations (`ListItr` methods):

```
Object retrieve();
void advance();
bool IsLast();
bool isPastEnd();
void previous();
bool IsFirst();
bool isPastStart();
```

List Operations (cont'd)

Main operations (`List` methods):

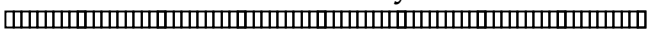
```
ListItr<Object> find(Object);
void insert(Object, ListItr<Object>);
void add(Object, ListItr<Object>);
void remove(Object);
bool isEmpty();
```

Creation/Deletion (`List` methods):

```
List();
~List();
void makeEmpty();
```


Array-based List Implementation

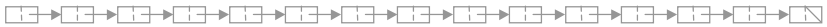
Store data in a normal C array:



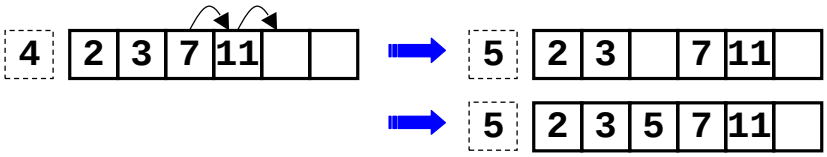
```
template <class Object>
class List {
private:


}
```

How would `ListItr<Object>` be implemented?

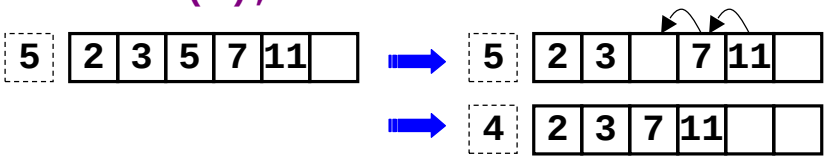
Array-based Insertion/Deletion



```
L.insert(5,3);
```




```
L.remove(5);
```



Evaluating Lists

What's the worst-case performance of…

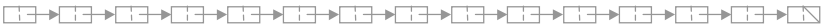
Array-based

```
ListItr<Object> find()
void insert()
void add()
void remove()
Object retrieve()
ListItr<Object> first()
ListItr<Object> kth()
ListItr<Object> last()
```

iterators

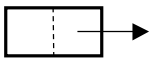
Other advantages/disadvantages?

Linked List Implementation



Store data in dynamically allocated nodes:

```
template <class Object>
class ListNode {
private:
  Object data;
  ListNode *next;
};
```

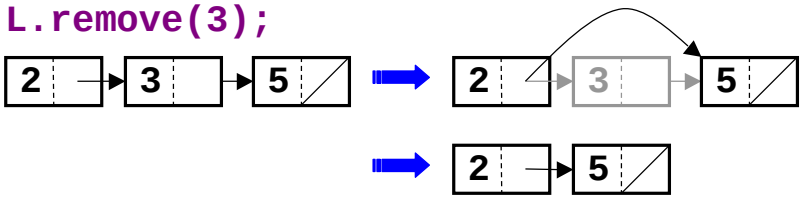


How would `ListItr<Object>` be defined?

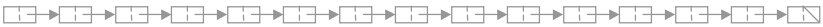
Linked Insertion/Deletion

`L.insert(3);`

`L.remove(3);`

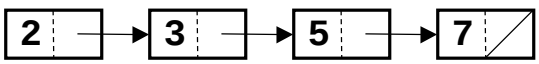


Coding Tips for Lists

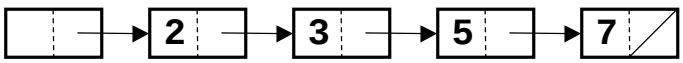


- Implementation is conceptually straightforward, but it's *easy* to make mistakes
- Testing strategy
  - "normal" case (as in pictures)
  - *boundary cases:*
    - empty list (full list?)
    - first element in list
    - last element in list
  - illegal cases

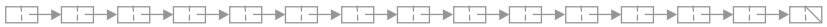
Design Decision: Header Node

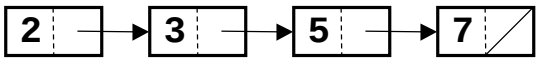


vs.

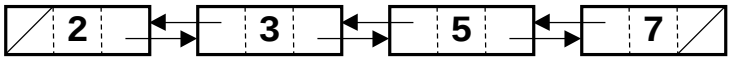


Design Decision: Doubly-Linked





vs.



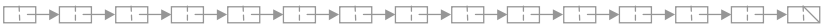
Design: Iterative *vs.* Recursive

Some list operations (*e.g.*, **`find()`**) have obvious recursive implementations:

```
ListItr<Object> find(Object val) {
  return findHelp(L.first(),val);
}
ListItr<Object> findHelp(ListItr<Object> pos,
                         Object val){
  if (pos.retrieve() == val) {
    return pos;
  } else if (pos.isPastEnd()) {
    return NULL;
  } else {
    pos.advance();
    return findHelp(pos,val);
} }
```

– Is this a reasonable use of recursion? A good use?

Applications



- Everything
  - class list
  - compilers: list of functions in a program, statements in a function
  - graphics: list of triangles to be drawn to the screen
  - operating systems: list of programs running

Reconsidering Array-Based Lists

- The book implies that the maximum size *must* be known in advance
- This isn't technically true:
  - allocate an initial (default) size
  - if we run out of space:
    - allocate a larger array
    - copy data values from original to new array
    - delete original array
    - swap pointers so that new array is used