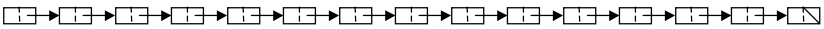
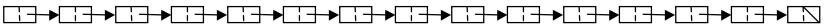


CSE 373: Queues

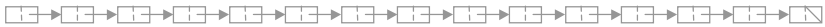
Chapter 3



Definition

Queue:

Queue Operations



Main Operations:

```
void enqueue(Object);
Object dequeue();
Object front();      // or getFront();
bool isEmpty();
```

Other Operations:

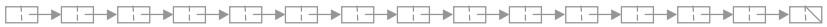
- normal creation/deletion operations
- again, generally no iteration operations

Queue Example

```
Queue Q;
int frontval, newval;

Q.enqueue(1);
Q.enqueue(1);
for (i=2; i<n; i++) {
  frontval = Q.dequeue();
  newval = frontval + Q.front();
  Q.enqueue(newval);
}
```

List-based Queue Implementation



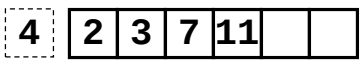
- As with Stacks, Queues are a specialized List
  - `enqueue()` = `insert()` at a specific end of the list
  - `dequeue()` = `remove()` from the *opposite* end
- Thus, Lists could be used to implement the Queue ADT
  - Similar advantages and disadvantages as the Stack case

Array-Based Queue Implementation

Naive approach:

`enqueue()` = insert at end of array

`dequeue()` = delete from front of array



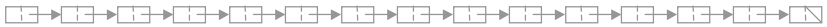
Running Time:

`enqueue()`:

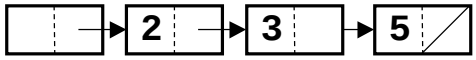
`dequeue()`:

How could we improve this?

Link-Based Queue Implementation



What are the challenges to making a link-based `enqueue()` and `dequeue()` efficient?



Evaluating Queue Implementations

List-based *Array-based* *Link-Based*

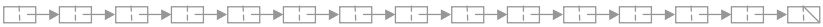
Operations:

`enqueue()`
`dequeue()`
`front()`
`isEmpty()`

Space:

Other:

Applications of Queues



Anything where "fairness" (FIFO) is required

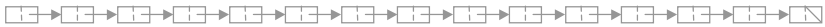
- **operating systems:** printer queues, storing user input, servers, scheduling processes
- **compilers (and in general):** worklists
- **graphics:** queue of things to render
- **applications:** list of recently used files
- **real-life:** lines at fast-food restaurants, "waiting for next available operator" lists
- **searching:** "breadth-first" searches

Introduction to Templates

The point:

- Lists, Stacks, and Queues are examples of ADTs that can store an arbitrary data type
  (*e.g.*, `List` of `integers`, `List` of `doubles`, `List` of `strings`)
- The implementation of these ADTs' operations is independent of the data type
  (*e.g.*, `insert()`/`delete()` didn't care which type of `List`)
- Templates support this separation of operation implementation and base type

Using Templates



declaration:

```
template <class Object>
class List {
private:
  ListNode<Object> *head;
  ListNode<Object> *tail;
};
```

use:

```
List<int>    myIntList;
List<double> myDblList;
List<string> myStrList;
```


Compiling Templates

```
#ifndef _LIST_H_
#define _LIST_H_
template <class Object>
class List {
… }

#include "list.cpp"
#endif
```

list.h

```
#include "list.h"

List<int> myIntList;
List<double> myDblList;

void main() {
  …
}
```

main.cpp

```
Object List<Object>::Remove() {
… }

void List<Object>::Add(Object x) {
… }
```

list.cpp

My Project

main.cpp

(*not* list.cpp!!!)