CSE 332: Data Structures

Winter 2014

Richard Anderson, Steve Seitz

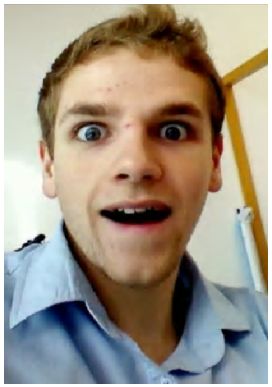
Lecture 1

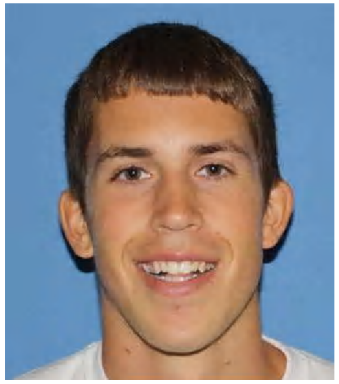
CSE 332 Team

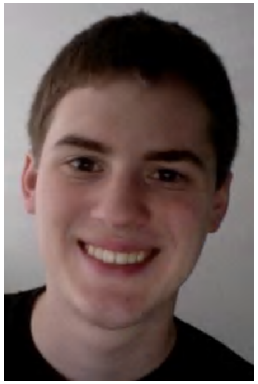
- Instructors: Richard Anderson, Steve Seitz
- TAs:


Jacob Gile


Hyein Kim


Aaron Nech


Daniel Noteboom


David Swanson


Sam Wilson

Today's Outline

- Introductions
- Administrative Info
- What is this course about?
- Review: queues and stacks

Course Information

Web page:

`http://www.cs.washington.edu/332`

Text: Weiss, *Data Structures & Algorithm Analysis in Java*, 3rd Edition, 2012.

(or buy 2nd edition—1/3 price on Amazon!)

Communication

Instructors

- cse332-instr@cs.washington.edu
- (or our individual addresses)

Announcements

- cse332a_wi14@u, cse332b_wi14@u
- (you are automatically subscribed @u)

Discussion

- Discussion board linked off home page

Written homeworks

Written homeworks (8 total)

- Assigned each Wednesday
- Due at the **start of class** following Wednesday
- No late homeworks accepted

Projects

- Programming projects (3 total, with phases)
  - In Java
  - Eclipse encouraged
  - Turned in electronically
  - Can use a “late day” for 1 project of your choice **Must email TA in advance**

Project 1 out today

- Soundblaster! Reverse a song
  - a.k.a., “backmasking”
- Use a stack
  - Implement as array and as linked list
- **Read the website**
  - Detailed description of assignment
  - Detailed description of how programming projects are graded
- Phase A due Monday, Jan 13 (11:59pm)
  - Electronic submission

Overall grading

Grading

- 25% - Written Homework Assignments
- 30% - Programming Assignments
- 20% - Midterm Exam (Feb 10)
- 25% - Final Exam (March 17)

Collaboration

Read policy on website carefully

- HWs must be done solo
  - But you can discuss problems with others as long as you follow the Gilligan's island rule
- Project 1 is solo (out today)
- Project 2 & 3 with a partner

Section

Meet on Thursdays

What happens there?

- Answer questions about current homework
- Previous homeworks returned and discussed
- Discuss the project (getting started, getting through it, answering questions)
- Finer points of Java, eclipse, etc.
- Reinforce lecture material

Homework for Today!!

Reading in Weiss

- Chapter 1 – (Review) Mathematics and Java
- Chapter 2 – (Next lecture) Algorithm Analysis
- Chapter 3 – (Project #1) Lists, Stacks, & Queues

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Steve's view of CSE

- 100 level courses, some 300 level
  - › how to do stuff
- This course
  - › ***Really cool*** ways to do stuff
- 400 level courses
  - › How to do ***really cool*** stuff

Common tasks

Common tasks

- Many possible solutions
  - › Choice of algorithm, data structures matters
  - › What properties do we want?

Example: Fibonacci

n	1	2	3	4	5	6	...
Fib	1	1	2	3	5	8	...

```
int fib( int n )
{
  if( n <= 2 )
     return 1;
  else
     return fib( n - 1 ) + fib( n - 2 );
}
```

Why should we care?

- Computers are getting faster
  - › No need to optimize

- Libraries: experts have done it for you

How to be an expert

- Tricks of the trade
  - Knowledge
  - Analysis
  - Style

Program Abstraction

Problem defn:

Algorithm:

Implementation:

Data Abstraction

Abstract Data Type (**ADT**):

Data Structure:

Implementation:

Terminology

- Abstract Data Type (ADT)
  - › Mathematical description of an object with set of operations on the object. Useful building block.
- Algorithm
  - › A high level, language-independent, description of a step-by-step process.
- Data structure
  - › A specific organization of the data to accompany algorithms for an abstract data type.
- Implementation of data structure
  - › A specific implementation in a specific language.

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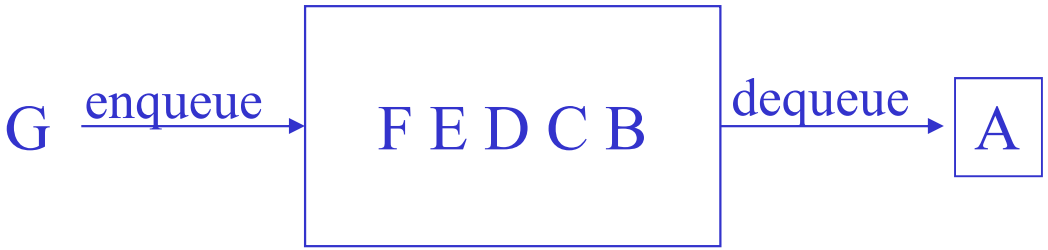
First Example: Queue ADT

- FIFO: First In First Out
- Queue operations
  - create
  - destroy
  - enqueue
  - dequeue
  - is_empty

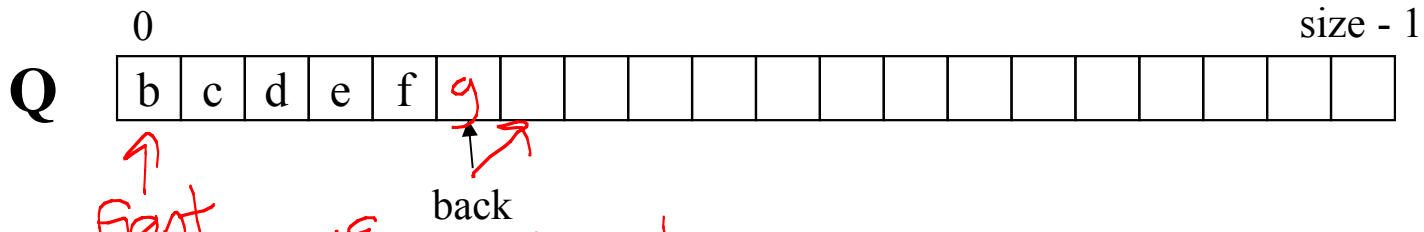


Queues in practice

- Print jobs
- File serving
- Phone calls and operators

(Later, we will consider “priority queues.”)

Array Queue Data Structure

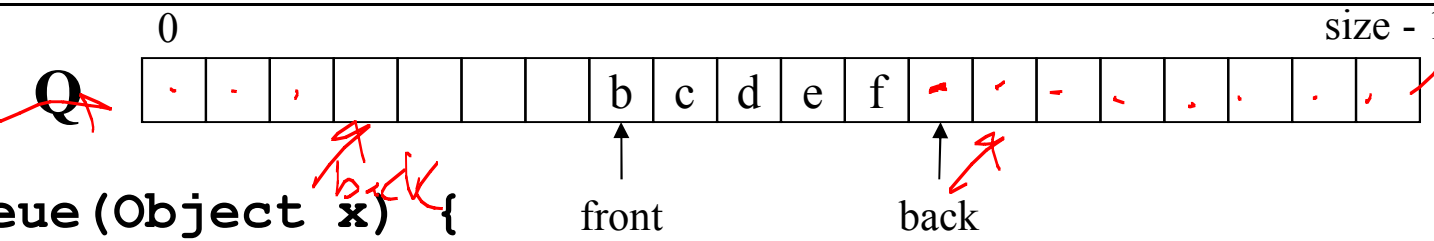



```
enqueue(Object x) {
    Q[back] = x
    back = (back + 1)
}

dequeue() {
    x = Q[0]
    shiftLeftOne()
    Back = (back - 1)
    return x
}
```

What's missing in these functions?

How to find K-th element in the queue?

Circular Array Queue Data Structure



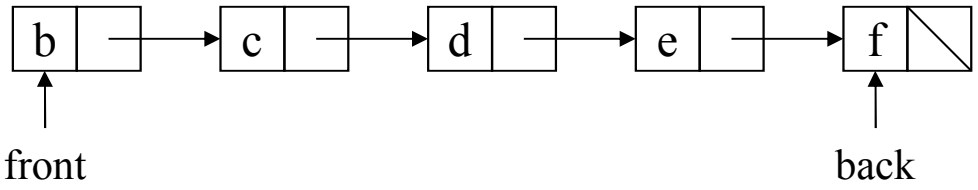

```
enqueue(Object x) {
    assert(!is_full())
    Q[back] = x
    back = (back + 1) % size
}

dequeue() {
    assert(!is_empty())
    x = Q[front]
    front = (front + 1) % size
    return x
}
```

How test for empty/full list?

How to find K-th element in the queue?

What to do when full?

Linked List Queue Data Structure




```
void enqueue(Object x) {
   if (is_empty())
        front = back = new Node(x)
   else {
        back->next = new Node(x)
        back = back->next
   }
}
bool is_empty() {
   return front == null
}
```

```
Object dequeue() {
   assert(!is_empty())
   return_data = front->data
   temp = front
   front = front->next
   delete temp
   return return_data
}
```

Circular Array vs. Linked List

- Advantages of circular array?

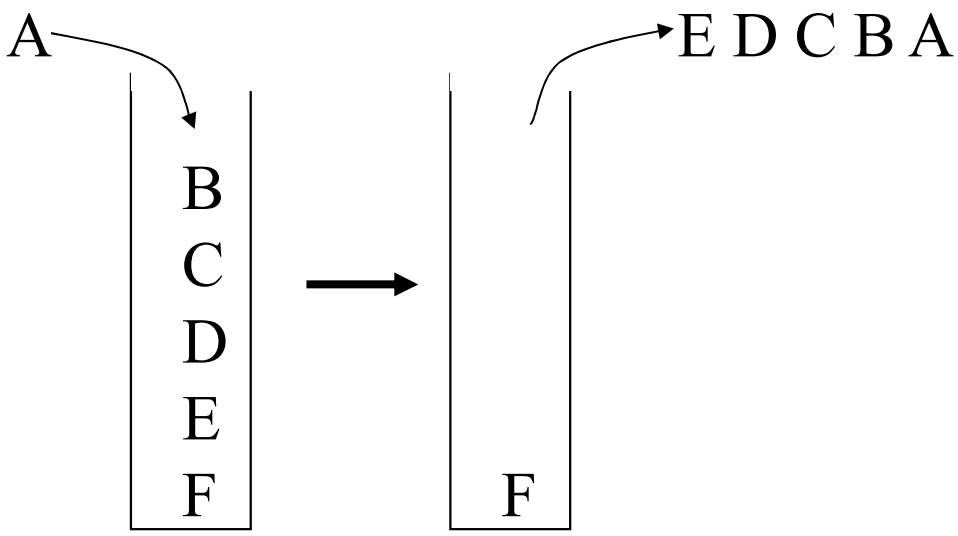
takes up less space*
easier to find Nth element
array has memory locality
easier to find size
faster to add/delete

- Advantages of linked list?

don't have to resize
easy add to the middle

Second Example: Stack ADT

- LIFO: Last In First Out
- Stack operations
  - create
  - destroy
  - push
  - pop
  - top
  - is_empty



Stacks in Practice

- Function call stack
- Removing recursion
- Balancing symbols (parentheses)
- Evaluating postfix or “reverse Polish” notation

Assigned readings

Reading in Weiss

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- Chapter 3 – (Project #1) Lists, Stacks, & Queues