CSE 373: Tradeoffs and Abstractions

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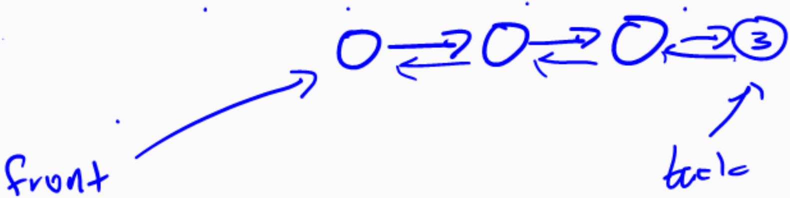
Friday Jan 5, 2017

Warmup questions:

Instructions:

- Recall: What's an ADT? What's a data structure? An implementation of a data structure?
- Skim the Queue ADT on your handout.
- Discuss: How would you implement a queue?

Possible queue implementations



enqueue?

enqueue 3

dequeue ?

Announcements

Course overload link: [redacted] (link given in lecture)

Other announcements:

- Overloading + looking for a partner? Talk to me after class.
- Project 1 out
- Important: get project setup done ASAP

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Setup tips and tricks:

- Suspect the spec is out-of-date? Shift-refresh in your browser
- Use Java 8, not 9
- When running into weird Eclipse issues, try restarting it

Reviewing CSE 143 material

Places to get practice

- Section 1 handouts
- Practice-it: https://practiceit.cs.washington.edu
- CSE 143 class website (17au or older)
- Project 1

Need help? Visit office hours!

ADTs

ADTs are just a tool for *communicating* with other programmers

This course focuses on *implementing* ADTs: implementing data structures

Why?

Why?

Why can't we just use `java.util.*`?

Why?

The dream: there's One Right Way to implement each ADT

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The reality: nothing's perfect

Why?

The dream: there's One Right Way to implement each ADT

The reality: nothing's perfect

But we can work around many *tradeoffs* by carefully *adapting* data structures and *abstracting* algorithms!

Tradeoffs

There are (often highly *non-obvious*) ways to organize information to enable *efficient* computations over data.

However, no method is perfect: there exists unavoidable **tradeoffs**.

Tradeoffs

Examples of tradeoffs:

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- Time vs space

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Core questions:

- What operations do I really need?
- What assumptions am I making about how my software will be used? (e.g. more lookups or inserts)

Case study: The List ADT

A list stores an ordered sequence of information.

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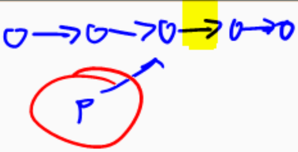
- **size**: return the number of elements in the stack

Tradeoffs



Goal: implement the List ADT

Compare and contrast: array list vs linked list

- Time needed to access *i*-th element

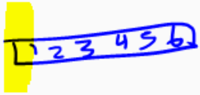
  array list : constant time

  LL : linear time

- Time needed to insert at *i*-th element

  AL : linear time

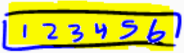
  LL : linear time

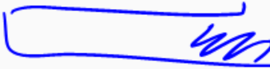


- Amount of space used overall:

  AL : sometimes wasted space

  LL : compact





- Amount of space used per element:

  AL : minimal spe

  LL : tiny extra space.

Tradeoffs

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- Time needed to access *i*-th element
  - Array list: immediate (constant time)
  - Linked list: must iterate to find *i*-th node
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- Amount of space used overall:
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  - Array list: must shift elements
  - Linked list: must iterate to *i*-th node
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- Amount of space used overall:
  - Array list: Potentially wastes space (after doubling)
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- Amount of space used per element:
  - Array list: No wasted space
  - Linked list: Slightly more space per element

A question:

How do we print out all the elements inside of a list?

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How do we print out all the elements inside of a list?

One idea:

```
for (int i = 0; i < myList.size(); i++) {
    System.out.println(myList.get(i));
}
```

How efficient is this if `myList` is an array list? A linked list?

AL: linear time

LL: quad

A problem:

We want to make linked list iteration fast. How?

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Idea!

- **Adapt** the list ADT
- **Abstract** the idea of iteration

A solution?

```java
Iterator<String> iter = myList.iterator();
while (iter.hasNext()) {
    String item = iter.next();
    System.out.println(item);
}
```

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- **delete**: delete the item at the *i*-th index
- **size**: return the number of elements in the stack
- **iterator**: returns an iterator over the list

The Iterator ADT

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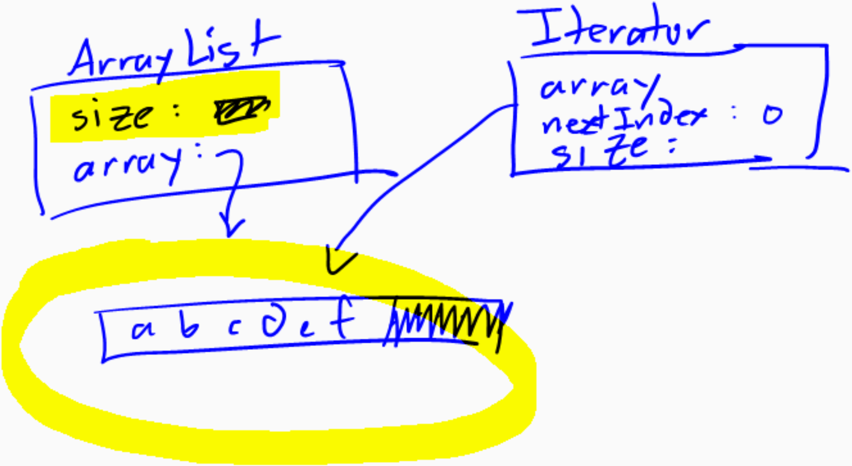
Supported operations:

- **hasNext**: returns ‘true’ if there’s another element left to yield and false otherwise
- **next**: returns the next element (if there is one)

Implementing an iterator: A plan of attack



Next time...

What is this ‘efficiency’ thing anyways?

Parting thoughts

Reminder: Overloading/partner concerns, talk to me after class

Supplemental resources: see resources page on class website for...

- Strategies on effectively testing code
- Info on JUnit
- Math review (logs, exponents, summations)

Have suggestions for more resources docs we should write?
Use feedback form.