CSE 373: Tradeoffs and Abstractions

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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
Announcements

Course overload link: [Given in lecture only]

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▶ Suspect the spec is out-of-date?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 are just a tool for communicating with other programmers.

This course focuses on implementing ADTs: implementing data structures.
Why can’t we just use java.util.*?
The dream: there’s One Right Way to implement each ADT
Why?

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

The reality: nothing’s perfect
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!
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*. 
Examples of tradeoffs:

- Time vs space
- Making one operation more efficient vs another
- Implementing extra behavior vs performance
- Simplicity and debuggability vs performance

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)
Tradeoffs

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A list stores an ordered sequence of information.
Case study: The List ADT

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It should support the following operations:

- **get**: returns the item at the $i$-th index
- **set**: sets the item at the $i$-th index to a given value
- **append**: add an item to the end of the list
- **insert**: insert an item at the $i$-th index
- **delete**: delete the item at the $i$-th index
- **size**: return the number of elements in the stack
Goal: implement the List ADT
Compare and contrast: array list vs linked list

- Time needed to access \( i \)-th element
- Time needed to insert at \( i \)-th element
- Amount of space used overall:
- Amount of space used per element:
Goal: implement the List ADT

Compare and contrast: array list vs linked list

- 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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  - Array list: Potentially wastes space (after doubling)
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  - **Linked list:** No wasted space

- **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?
A question:

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

One idea:

```java
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?
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
Iterator<String> iter = myList.iterator();
while (iter.hasNext()) {
    String item = iter.next();
    System.out.println(item);
}
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- **size**: return the number of elements in the stack
- **iterator**: returns an iterator over the list
An iterator “wraps” some sequence.
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It yields each subsequent element one by one on request.
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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)
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.