CompSci 100e
Program Design and Analysis II

February 17, 2011

Prof. Rodger
Announcements

• Test 1
  – Closed book, closed notes
  – Except can bring 4 sheets of paper written front/back

• Test 1 Topics
  – Strings, Sets, Maps - hashing, arrays and ArrayLists, Classes, Inheritance, Comparable, Files, Scanner, Analysis

• Will review in Lab Fri/Mon with old test questions
  – Try test questions before coming to lab, don’t look at solutions
  – Practice writing code on paper!
Analysis

• ArrayList – elements not in order
  – Assume n items already in the ArrayList
  – How long does it take to put one new item in?
    • myList.add(value)
    • Worst case?
    • Average case?

• ArrayList – elements in sorted order – maintain property
  – Assume n items in ArrayList
  – How long does it take to put one new item in?
    • myList.add(value)
    • Worst case?
    • Average case?
Analysis

- HashMap
  - Assume n items already in the map
  - How long does it take to put one new item in?
    - myMap.put(key, value)
    - Worst case?
    - Average case?
Analysis

- TreeMap
  - Assume n items already in the map
  - How long does it take to put one new item in?
    - myMap.put(key, value)
    - Worst case?
    - Average case?
Analysis

• TreeSet
  – Assume $n$ items already in the set
  – How long does it take to put one new item in?
    • `mySet.add(value)`
    • Worst case?
    • Average case?
Binary Search

• Given a sorted array of n names, how do you find a name?

• How does binary search work?
• Can you apply binary search to any array?

• How long does binary search take?
  – Worst case?
  – Average case?
Markov

• Be sure to include analysis
  – Can put in your README file
  – OR include in another document (mention in README file if it is in another document)

• Read the assignment carefully after completing the coding part
Problem

- Given data on books in a library
  - Title, author, year published
  - May have multiple copies of books
- Search for books
  - Sort by title
  - Sort by author
  - Sort by number of copies
  - (we will not focus on how to sort for this problem, just use Collections.sort());
<table>
<thead>
<tr>
<th>Title</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1421: The Year China Discovered America</td>
<td>1</td>
</tr>
<tr>
<td>Abraham: A Journey to the Heart of Three P's</td>
<td>1</td>
</tr>
<tr>
<td>Balzac and the Little Chinese Seamstress</td>
<td>1</td>
</tr>
<tr>
<td>Bias: A CBS Insider Exposes How the Media Messes Up America</td>
<td>1</td>
</tr>
<tr>
<td>Bush at War: Inside the Bush White House</td>
<td>1</td>
</tr>
<tr>
<td>By the Light of the Moon</td>
<td>1</td>
</tr>
<tr>
<td>Fast Food Nation: The Dark Side of the All-American Diet</td>
<td>1</td>
</tr>
<tr>
<td>For Spacious Skies: The Uncommon Journey</td>
<td>1</td>
</tr>
</tbody>
</table>

Found 75 books!
Sort by Count

We have 1 copy of The Woman Who Wouldn't Talk by Susan McDoug.
We have 1 copy of On Top of the World: Cantor Fitzgerald, Hero.
We have 1 copy of Into the Woods by V. C. Andrews published.
We have 1 copy of Walter, the Farting Dog by William Kotzwinkle.
We have 2 copies of Harry Potter and the Deathly Hallows (Book 7).
We have 3 copies of Harry Potter and the Order of the Phoenix.
We have 5 copies of Harry Potter and the Half-Blood Prince.

message
Found 75 books!
How does one sort a type?

• ints, doubles: Compare with $<$, $>$, $==$  
• Strings: how do you compare?
• Book objects: how do you compare them?
Comparable interface

- public interface Comparable
- Classes must implement Comparable interface
- public class Book implements Comparable
- Book must have a compareTo method defined
- Another Example:
  - WordNgram implements Comparable to compare two WordNgrams
How does compareTo work?

• Compares two objects of the same type
• Returns an int
  – returns -1 if first object < second object
  – returns 0 if objects are equivalent
  – returns 1 if first object > second object
• What does compare two Book types mean?
  – By author
  – by title
  – by counts and then author
Classwork today – Amazon Lite

• Library Class
  – Read in the data to create Book object and put them in the library
  – findBooks to return a list of books on some criteria

• Book class
  – Write the method equals to return true if two books have the same author and title
  – Write the method matches – finding a word in a string
Classwork today (more)

• We will compare books several ways
  – 1) We will create Specific Comparator classes and pass them to a sorter
     • TitleComparator (DONE)
     • AuthorComparator
     • CountComparator
  – 2) We will change the Book class to make it Comparable
     • Implement the compareTo method based on titles
EXTRA SLIDES BELOW HERE
Analysis

• ArrayList – elements not in order
  – Assume n items already in the ArrayList
  – How long does it take to put one new item in?
    • myList.add(value)
    • Worst case? $O(1)$
    • Average case? $O(1)$

• ArrayList – elements in sorted order – maintain property
  – Assume n items in ArrayList
  – How long does it take to put one new item in?
    • myList.add(value)
    • Worst case? $O(n)$
    • Average case? $O(n)$
Analysis

• HashMap
  – Assume \( n \) items already in the map
  – How long does it take to put one new item in?
    • myMap.put(key, value)
    • Worst case? \( O(n) \)
    • Average case? \( O(1) \)
Analysis

• TreeMap
  – Assume n items already in the map
  – How long does it take to put one new item in?
    • myMap.put(key, value)
    • Worst case? \( O(n) \)
    • Average case? \( O(\log n) \)
  – How would you know that?
    • You wouldn’t, because you don’t know what a tree is yet, just have to take my word...
Analysis

• TreeSet
  – Assume n items already in the set
  – How long does it take to put one new item in?
    • mySet.add(value)
    • Worst case? O(n)
    • Average case? O(log n)
  – How would you know that?
    • You wouldn’t, because you don’t know what a tree is yet, just have to take my word…
Binary Search

• Given a sorted array of n names, how do you find a name?

• How does binary search work?
• Can you apply binary search to any array?

• How long does binary search take?
  – Worst case? $O(\log n)$
  – Average case? $O(\log n)$