Lecture Set #18: Collections

1. New Looping construct
   1. for each loop
2. Collections
   1. Stack
   2. ArrayList

Collections in Java

- Arrays are collections
  - Arrays are objects
  - Arrays are sequences of elements in base type
  - These elements are collected together in one object: the array
- Java includes many other collection mechanisms
  - Arrays good for some applications (fixed-length sequences), not others (varying-length sequences)
  - Other collections tuned for different purposes
  - General observation holds, however:
    - Collections are objects ...
    - ... that contain other objects in a given type
- We'll study two (more in CMSC132): Stack, ArrayList
for ... each ... in

- New construct available in Java 1.5 (not available in older versions of Java)
- Use with arrays
- Use with any iterable collection
- Limitations:
  - modifications limited
    - can’t add items to the list being iterated over
    - can’t remove items from the list being iterated over
    - can’t replace items in the list being iterated over
  - access only one
    - only a single collection can be traversed at a time
    - can’t access the one before or the one after on this iteration
  - limited to forward and one at a time
    - can’t traverse the list in the reverse order
    - can’t go to every other element or any variation

Stacks in Java

- Recall: a stack is a data structure ("device" for holding values) – FILO (First In, Last Out)
- Typical operations on a stack
  - push: add a new value into the stack
  - pop: remove the most recently added value still in stack
  - top: return the most recently added value in stack
    Note: Java calls this “peek”
  - is empty: returns true if the stack is currently empty or false otherwise
Example of stack concept (not Java specific)

- Stack s
  - s.isEmpty() == ?
    - true
  - s.push (3);
  - s.isEmpty() == ?
    - false
  - s.push (4);
  - s.peek == ??
    - 4
  - s.pop ();
  - s.push (5);
  - s.peek == ??
    - 5

Stacks in Java (cont.)

- Java includes a generic class for stack objects
  - Stack objects contain other objects
  - All objects in stack must have same type
  - Only objects may be stored in stacks (no primitive-type values)
- Syntax: Stack<E>
  - Stack<E> is a generic class
    - E is a class variable representing the base type
    - Replace E by a specific type to get a stack of that type of elements
  - Class is in java.util package
- Documentation: [http://java.sun.com/j2se/1.5.0/docs/api/java/util/Stack.html](http://java.sun.com/j2se/1.5.0/docs/api/java/util/Stack.html)
- See example: StackExample.java
  ```java
  Stack<String> stack = new Stack<String>();
  Creates a stack of strings
  - extend this to be stack of cats
  - extend this to be stack of integer values
  ```
ArrayList Collection

- Like arrays ... but support for inserting/deleting new elements
  - Sequences of elements
  - All elements must be in same (base) type
- Syntax: `ArrayList<E>`
- Documentation: [http://java.sun.com/j2se/1.5.0/docs/api/java/util/ArrayList.html](http://java.sun.com/j2se/1.5.0/docs/api/java/util/ArrayList.html)
- See example: `ArrayListExample.java`
  - `ArrayList<java.lang.String> a = new ArrayList<java.lang.String>();`
    Creates an `ArrayList` of strings
  - `Collections.sort` may be used on `ArrayList<java.lang.String>` objects?
- Reason
  - `String` implements `Comparable` interface
  - `ArrayList<E>` implements `List<E>` interface

Mutable Strings

- **Strings are immutable**
  - Once a String object is created, it cannot be altered
  - For String objects, reference = shallow = deep copying (why?)
- Sometime mutable strings would be handy
  - Sometimes a small change needs to be made to a string (e.g. misspelled name)
  - Don’t want to create a whole new `String` object in this case
- **StringBuffer**: Java’s class for mutable Strings
StringBuffer Basics

- See documentation at:
  http://java.sun.com/j2se/1.5.0/docs/api/java/lang/StringBuffer.html
- Main methods
  - append: add characters to end
  - insert: add characters in middle
  - delete: remove characters
- Note
  - append, insert return object of type StringBuffer
  - This is alias to object that the methods belong to!
- See StringBufferExample.java