Sets and Maps

Department of Computer Science
University of Maryland, College Park
Sets

- Properties
  - Collection of elements without duplicates
  - No ordering (i.e., no front or back)
  - Order in which elements added doesn’t matter
- Implementation goal
  - Offer the ability to find / remove element quickly
  - Without searching through all elements
How Do Sets Work in Java?

- Finding matching element is based on equals() method
- To build a collection for a class
  - Need to define your own `equals(Object)` method
  - Default equals( ) uses reference comparison
    - I.e., `a.equals(b) → a == b`
    - `a, b` equal only if reference to same object
  - Many classes have predefined equals( ) methods
    - `Integer.equals( ) → compares value of integer`
    - `String.equals( ) → compares text of string`
Set Concrete Classes

- **HashSet**
  - Elements must implement `hashCode()` method
- **LinkedHashSet**
  - HashSet supporting ordering of elements
  - Elements can be retrieved in order of insertion
- **TreeSet**
  - Elements must be comparable
    - Implement Comparable or provide Comparator
    - Guarantees elements in set are sorted
- **Example**: See SetsMapsCode
Map Definition

- Map (associative array)
  - Unordered collection of keys
  - For each key, an associated object
  - Can use key to retrieve object
- Can view as array indexed by any (key) value
- Example
  A["key1"] = …
Map Interface Methods

• Methods
  • void put(K key, V value) // inserts element
  • V get(Object key) // returns element
  • V remove(Object key) // removes element
  • int size() // key-value mappings
  • void clear() // clears the map
  • boolean containsKey(Object key) // looks for key
  • boolean containsValue(Object value) // looks for value
  • boolean isEmpty() // empty map?
  • Set<K> keySet() // entire set of keys
  • Collection<V> values() // values in the map
Map Concrete Classes

- HashMap
  - Elements must implement `hashCode()` method
- LinkedHashMap
  - HashMap supporting ordering of elements
  - Elements can be retrieved in order of insertion
- TreeMap
  - Elements must be comparable
    - Implement Comparable or provide Comparator
  - Elements can be retrieved in sorted order
- Example: See SetsMapsCode
Map Properties

- Map keys & map objects
  - Can also treat keys & values as collections
    - Access using keySet( ), values( )
- Aliasing
  - Each key refers only a single object
  - But object may be referred to by multiple keys
- Keys & values may be of complex type
  - Map<Object Type1, Any Object Type2>
  - Including other collections, maps, etc…
Map Implementation

- Implementation approaches
  - Two parallel arrays
    - Unsorted
    - Sorted
  - Linked list
  - Binary search tree
  - Hash table
- Java Collections Framework
  - TreeMap → uses red-black (balanced) tree
  - HashMap → uses hash table
Map Hierarchy

Map

SortedMap

TreeMap

AbstractMap

HashMap

LinkedHashMap

Red ➔ Interface
Black ➔ Class
Collection & Map Hierarchies

Interface (red)
Class (black)