CMSC 132:
Object-Oriented Programming II

Sets and Maps

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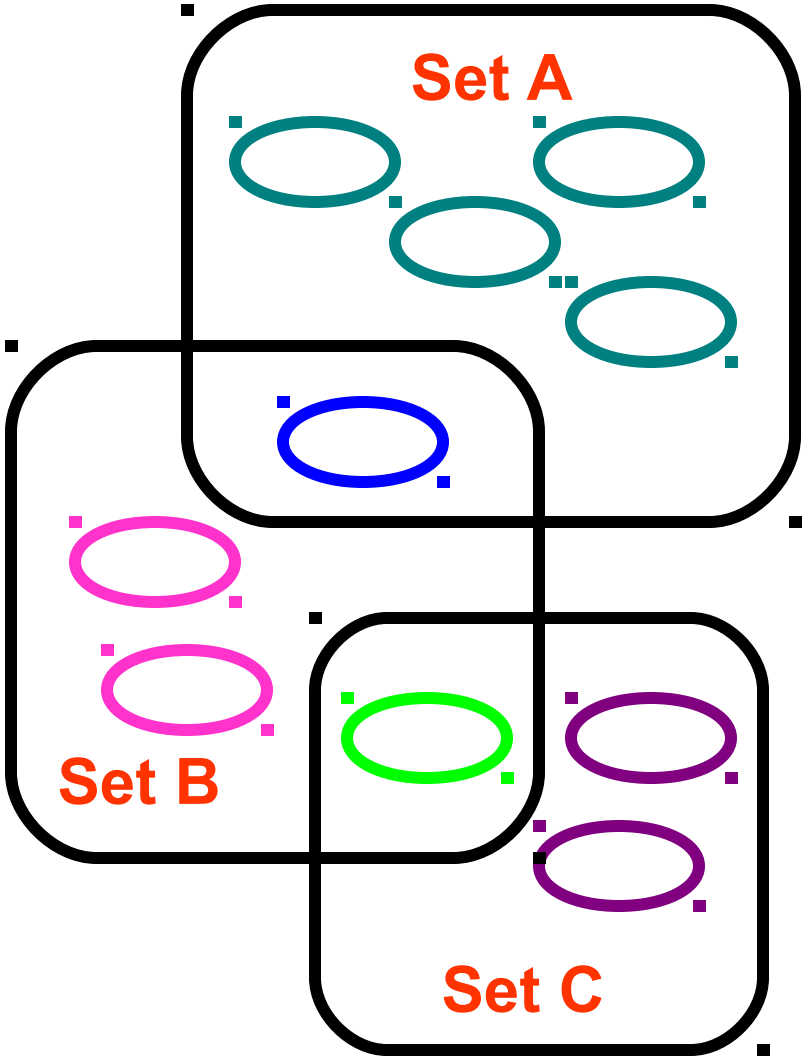
How Do Collections Work in Java?

- Elements are NOT copied when inserted
- Collection contains references, not objects
- Finding matching element is based on equals( )
- To build a collection for a class
  - Need to define your own equals(Object) method
  - Default equals( ) uses reference comparison
    - Just like a == b
    - a and b are only equal if they refer to the same object

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



Set Concrete Classes

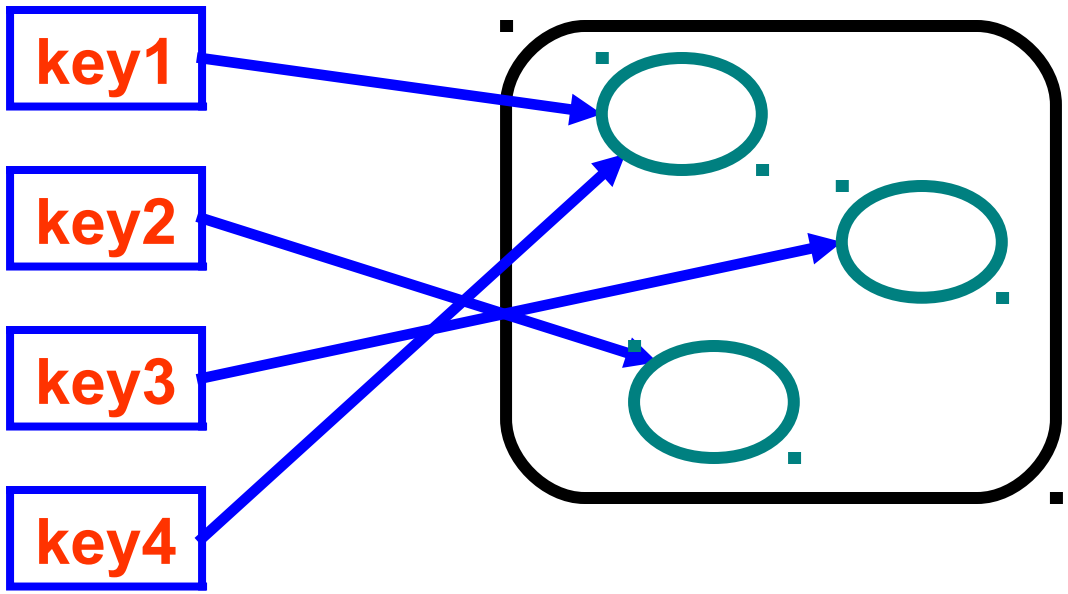
- HashSet
  - Uses Hash Table
  - Elements must implement hashCode( ) method
- LinkedHashSet
  - Uses Hash Table AND Doubly Linked List
  - Elements can be retrieved in order of insertion
  - Elements must implement hashCode() method
- TreeSet
  - Elements must be comparable
    - Implement Comparable or provide Comparator
  - Guarantees elements in set are sorted

Sets Example

Coding Example about Sets…

Map Definition

- Map
  - Unordered collection of keys
  - For each key, an associated value
  - Can use key to retrieve value



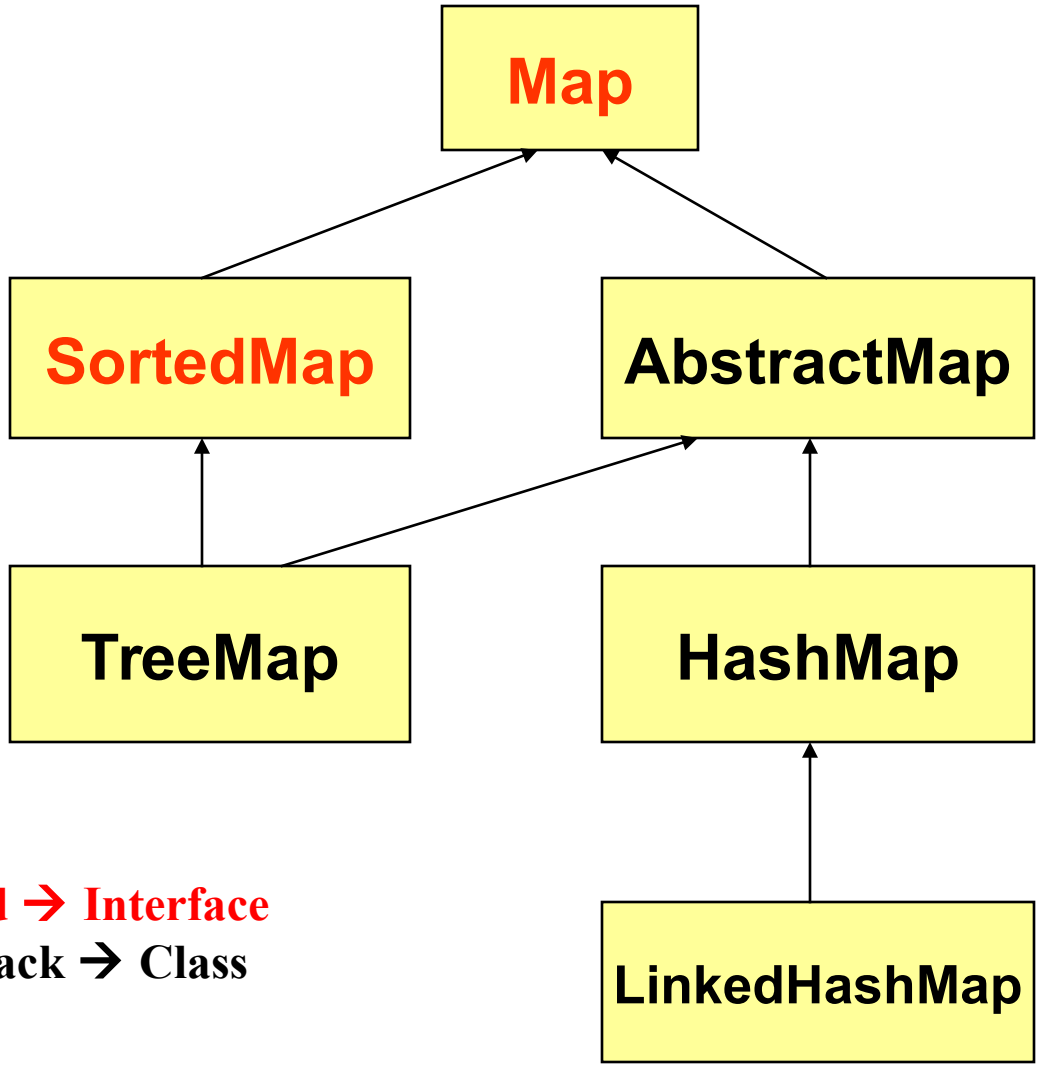
Map Properties

- Map “keys” & map “values”
  - Aliasing
    - Each key is associated with ONE value
    - But same value may be referred to by multiple keys
  - Can also treat list of “keys” & list of “values” as collections
    - Access using keySet( ), values( )
  - Keys & values may be of complex type
    - Map<Object Type1, Any Object Type2>
    - Including other collections, maps, etc…

Map Concrete Classes

- HashMap
  - Keys must implement hashCode( ) method
- LinkedHashMap
  - HashMap supporting ordering of elements
  - Keys/Values can be retrieved in order of insertion
  - Keys must implement hashCode() method
- TreeMap
  - Keys must be comparable
    - Implement Comparable or provide Comparator
  - Keys/Values can be retrieved in sorted order of Keys

Map Hierarchy



Red → Interface
Black → Class

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

Coding Examples

- **See the package called “maps” on your CVS repository.**