Computer Science

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Lecture 23
Anagram Groups Problem

- Given an dictionary of words.
- Find and print all anagram groups of size two or larger.
- Print them in increasing order of size.
- An anagram group is a collection of words that are anagrams of each other.
- Example: \{bard, brad, drab\} is an anagram group of size three.
Java Collections Framework

• The Java collections framework (JCF) is a set classes and interfaces that implement commonly reusable collection data structures. (Wikipedia)

• A collection — sometimes called a container — is simply an object that groups multiple elements into a single unit. Collections are used to store, retrieve, manipulate, and communicate aggregate data. (Oracle Java Tutorials)
Examples of JCF Interfaces
(Oracle Java Tutorials)
Examples of JCF Classes

- **ArrayList**: (Similar to our `FlexibleArray`.)
- **LinkedList** (Similar to our `ListDL`.)
- **TreeSet** (Similar to our `BSTree`.)
- **HashSet** (Alternative implementation of set container.)
- **TreeMap** (Similar to our `AssociativeMapBST`.)
- **HashMap** (Alternative implementation of map container.)
Java Collection Classes
(Wikipedia)
Bucket Sort

• Partition a set of objects into subsets, which we will call “buckets”.
• Each bucket is labeled with a key.
• The key represents a property shared by the contents.
  – E.g., Partition students in class by birth month.
  – E.g., Partition words in dictionary by number of characters.
MultiMap: An Interface for Classes
Implementing Bucket Sort

```java
public interface MultiMap<K extends Comparable<K>, V> {
    void put(K key, V value);
    List<V> get(K key);
    Set<K> keySet();
}
```
TreeMultiMap

- Implements the `MultiMap<K, V>` interface.
- Uses a JCF `TreeMap<Km, Vm>` to store the data:
  - Key type `Km` is the `MultiMap` key type `K`.
  - Value type `Vm` is a `LinkList<D>` where `D` is the `MultiMap` value type.
public class TreeMultiMap<K extends Comparable<K>, V> implements MultiMap<K,V> {

    TreeMap<K,LinkedList<V>> theMap;

    public TreeMultiMap() {
        this.theMap = new TreeMap<K,LinkedList<V>>();
    }

    // ... Omitted ...
}
public void put(K key, V value) {
    LinkedList<V> values = theMap.get(key);
    if (values == null) {
        values = new LinkedList<V>();
        theMap.put(key, values);
    }
    values.add(value);
}

public LinkedList<V> get(K key) {
    return theMap.get(key);
}

public Set<K> keySet() {
    return theMap.keySet();
}
Anagram Groups (Version 1)

• Sort words into buckets corresponding to anagram groups:
  – Key is sorted character string.
  – Value is word.

• Iterate over key set (sorted character strings) and print the bucket contents (anagram group) for each key.
Anagram Groups (Version 2)

• Sort anagram groups into buckets corresponding to group size:
  – Key is number of words in the anagram group.
  – Value is the anagram group.

• Iterate over key set (sizes of groups) and print the bucket contents (all anagram groups of that size) for each key.