

### ABOUT COLLECTIONS

- Problem: naming a bunch of things Cannot use variables ... will run out of names!
- Solutions
   Traditional approach: name + index = array
   Modern approach: object with API = list, set, map
- Comparison Arrays have no API and suffer from fixed allocation The modern collection framework has a rich API
- But we occasionally use arrays
   For compatibility with low-level API (e.g. split and args)

# ARRAYS (SEE SEC. L.2.1.E)

- Represent a collection of entities of the same type
- Declaration: type[] name; e.g. int[] bag;
- Instantiation: new type[size], e.g.
   bag = new int[100];
- Refer to elements by name[index], e.g. bag[0] = 123; bag[1] = bag[0] + 5;

# ARRAYS (SEE SEC. L.2.1.E)

- name.length represents the array's length
- Indices go from 0 to length 1
- Multidimensional arrays can also be used

## EXAMPLE 1

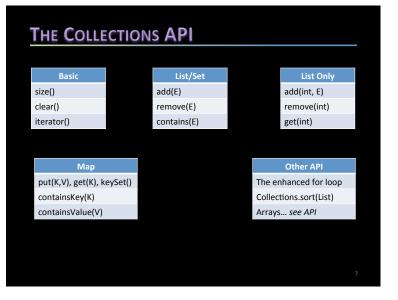
If we pick an integer in [1,1M] randomly, how likely is it to get one whose digit sum is divisible by 7?

Compute the probability by sampling 10% of those integers and store the sample in a collection.

- 1. Use Arrays See SumDiv7\_array.java
- 2. Use Collections See SumDiv7\_coll.java

# JAVA COLLECTION FRAMEWORK

- List vs Set vs Map List: may contain duplicates and elements are ordered. Set: no duplicates and no order. Map: key-value pairs, key unique.
- The Interfaces (aka Abstract Data Types) List<E>, Set<E>, and Map<K,V> (use generics)
- The Classes (aka Implementations) List: ArrayList and LinkedyList; Set: HashSet and TreeSet Map: HashMap and TreeMap
- Common APIs size(), clear(), iterator(), toString() Methods to insert, delete, and search → CRUD



# NOTES ON COLLECTIONS

- add(E e) on a set returns false if e is already in it (for a list always returns true)
- remove(E e) returns true iff e is found in the set or list; for a list removes only first occurrence
- Collections.sort(List <E> I) rearranges I to make it sorted (according to natural order)
- Arrays.asList(E[] a) returns a List representation of array a

# NOTES ON COLLECTIONS

 Traversing a List<E> bag i.e. going through all of its elements one by one, is a common operation:

for (E e: bag) {

System.out.println(e);

}

- Similarly for sets
- For lists, can also do an indexed traversal:
  - for (int i = 0; i < bag.size(); i++) {

E e = bag.get(i); System.out.println(e);

}

## EXAMPLE 2

*Given a list, determine whether it contains duplicate elements.* 

Can be done in 3 ways:

- 1. Sort the list and then traverse it to check for adjacent duplicates
- 2. Create a set and then try to add each list element to it checking if add succeeds
- 3. Traverse the list, and for each element traverse the list again to see if it occurs elsewhere

## EXAMPLE 2 - SORTING-BASED SOLUTION

```
Collections.sort(bag);
```

```
boolean distinct = true;
```

```
for (int I = 0; I < bag.size() - 1; i++) {
```

distinct = distinct && !bag.get(i).equals(bag.get(i+1));

```
}
```

```
    Can also exit as soon as a duplicate is found:
for (int i = 0; i < bag.size() - 1 && distinct; i++) {
distinct = !bag.get(i).equals(bag.get(i+1));
```

}

# EXAMPLE 2 - SET-MAKING SOLUTION

Set<Integer> tmp = new HashStet<Integer>(); boolean distinct = true; for (int I = 0; I < bag.size() ; i++) { distinct = distinct && tmp.add(bag.get(i)); } • Can also exit as soon as a duplicate is found: for (int i = 0; i < bag.size() && distinct; i++) { distinct = tmp.add(bag.get(i)) ;

}

# Example 2 - Draversal-BaseD Solution kgene and is the end of the end of

## EXAMPLE 3

Given a long sentence, find all its words; the distinct ones (regardless of case); display them; sort them; and then locate the longest and most frequent ones.

A "word" is defined as a sequence of characters terminated by space, punctuation, or end-of-string.

- 1. Use split with a regex
- 2. Turn array to a collection
- 3. Use collection API

See WordSmith.java

## EXERCISES

- Given a list<E>, pick a random element from it.
- Given a set<E>, pick a random element from it.
- Given a map<K,V>, pick a random value from it.

Given a list<E>, print it sorted or reverse-sorted.

- Given two lists <E>, merge them.
- Given two lists <E>, intersect them.

Given a map<K,V>, invert it assuming distinct values.
 Given a map<K,V>, invert it using largest value to break ties.

Given a map<K,V>, invert it into <V,List<K>>

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## INHERITANCE IN A NUTSHELL

#### Abstract Declaration Reserve a spot for a "GTA university student", a "YU student", an "EECS student", ... Expect a parent but accept a child.

### Removes Redundancy

If classes A and B share 80% of the methods, why not put those methods in parent class C and have A and B extend it.

### Exercises Control

If classes A and B share 80% of the API, why not put the shared API headers in interface C and have A and B implement it.

### Provides Defaults

All Java classes extend Object. Android gadgets extend View.