CS 2110, SP24

Discussion 5: Java Collections library

Mini-Lesson: ADTs and Java Collections library

ADTs, data structures, interfaces, classes

- **Abstract Data Types (ADTs)**: *Operations*, *restrictions*, and *guarantees* for a collection of objects
  - Behavior is specified from client's point of view
  - No implementation details!

- ex) A list is a collection of elements with a defined order.

- **ADT** operations can be declared and specified in a Java `interface`

Java's `List<E>` interface

- Interfaces for many ADTs in `java.util` package
  - Known as Java Collections Framework
- Generic interfaces – type parameter E for type of **e**lements
- List operations:
  - `size()      // not "length"`
  - `get(i)      // returns an E`
  - `set(i, e)   // e has type E`
  - `add(i, e)`
  - `remove(i)`
  - `contains(e)`

ADTs, data structures, interfaces, classes

- **ADT** operations can be declared and specified in a Java `interface`
- A Java `class` implementing such an interface will use **data structures** to implement that functionality
- Multiple classes can implement the same interface using different data structures

List implementations

- JavaDoc: All Known Implementing Classes
  - `ArrayList<E>`: Uses a resizable array
  - `LinkedList<E>`: Uses a (doubly) linked list
- All support the same core operations

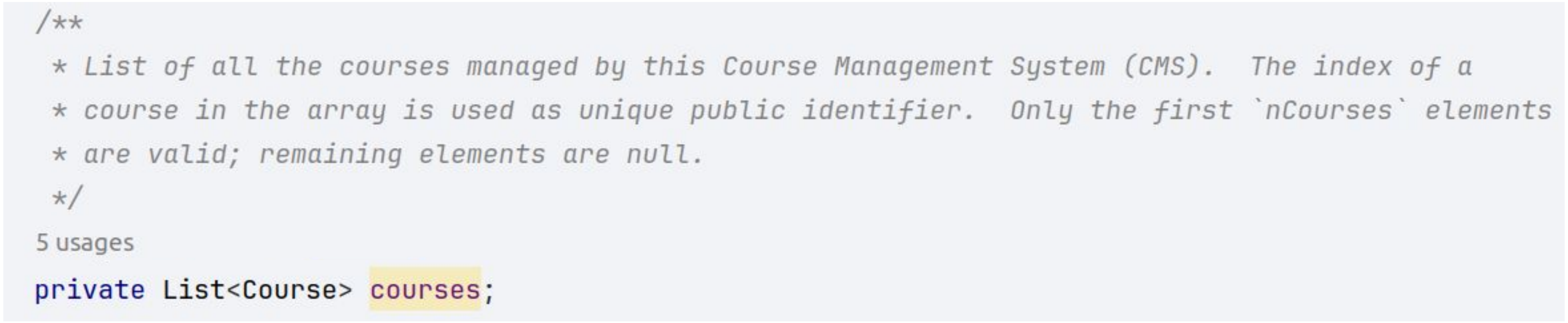
Other collection ADTs

- `Collection<E>`
  - Keeps track of objects that have been added, but does not remember order
- Set<E>
  - A collection with no duplicates. Common operation: contains(e)
- SortedSet<E>
  - Iteration order is guaranteed to be sorted (according to value comparisons)

Data structures for these (binary search trees, hash tables) will be taught later, but as a *client*, you can use them now (HashSet, TreeSet)

Hindsight on A2…

- Can replace CMSu's arrays of Students and Courses with Lists



```
/**
 * List of all the courses managed by this Course Management System (CMS).  The index of a
 * course in the array is used as unique public identifier.  Only the first `nCourses` elements
 * are valid; remaining elements are null.
 */
5 usages
private List<Course> courses;
```

- Can replace `StudentSet` by leveraging standard class with a custom parametric type
  - Or could implement StudentSet using a field of type Set<Student> - composition

Iterating over collections

- Common operation for all collections: ability to **enumerate** all elements (order may be unspecified)
- Most convenient: "enhanced for-loop"

```
Collection<String> c = ...;
for (String s : c) {
    // Use s
}
```

- Uses `Iterators` under the hood: `hasNext()` & `next()`

Enhanced for-loops are translated into while loops

```java
List<String> names = …;


for (String name : names) {
    …
}
```

```java
List<String> names = …;
Iterator<String> it =
  names.iterator();
while (it.hasNext()) {
    String name = it.next();
    …
}
```