Arrays of Objects

October 8, 2007

ComS 207: Programming I (in Java)
Iowa State University, FALL 2007
Instructor: Alexander Stoytchev

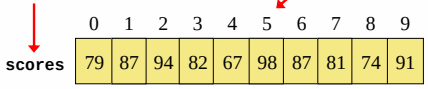
Quick review of last lecture

Arrays

- An *array* is an ordered list of values

The entire array has a single name

Each value has a numeric *index*

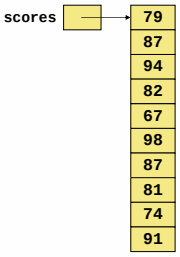


An array of size N is indexed from zero to N-1

This array holds 10 values that are indexed from 0 to 9

Arrays

- Another way to depict the `scores` array:



Declaring Arrays

- The `scores` array could be declared as follows:

```
int[] scores = new int[10];
```

- The type of the variable `scores` is `int[]` (an array of integers)
- Note that the array type does not specify its size, but each object of that type has a specific size
- The reference variable `scores` is set to a new array object that can hold 10 integers

Declaring Arrays

- Some other examples of array declarations:

```
float[] prices = new float[500];

boolean[] flags;
flags = new boolean[20];

char[] codes = new char[1750];
```

The iterator version of the `for` loop

```
for (int score : scores)
   System.out.println (score);
```

- This is only appropriate when processing all array elements from top (lowest index) to bottom (highest index)

What for/in can't do

```
int[] primeNums = {2, 3, 5, 7, 11, 13, 17, 19};

for (int i=0; i< primeNums.length; i++)
  {
      System.out.print("primeNums[" + i + "]= “);
      System.out.println(primeNums[i]);
  }
```


What for/in can't do

```
String word="Test";

for (int i=0; i< word.length(); i++)
{
   if(i>0)
     System.out.print(“, “);

   System.out.print( word.charAt(i) );
}
```


Other Stuff from Sections 7.1 & 7.2

Initializer Lists

- An *initializer list* can be used to instantiate and fill an array in one step
- The values are delimited by braces and separated by commas
- Examples:

```
int[] units = {147, 323, 89, 933, 540,
               269, 97, 114, 298, 476};

char[] letterGrades = {'A', 'B', 'C', 'D', ’F'};
```


Initializer Lists

- Note that when an initializer list is used:
  - the new operator is not used
  - no size value is specified
- The size of the array is determined by the number of items in the initializer list
- An initializer list can be used only in the array declaration
- See `Primes.java` (page 381)

Example: Primes.java (page 381)

Bounds Checking

- Once an array is created, it has a fixed size
- An index used in an array reference must specify a valid element
- That is, the index value must be in range 0 to N-1
- The Java interpreter throws an `ArrayIndexOutOfBoundsException` if an array index is out of bounds
- This is called automatic *bounds checking*

Bounds Checking

- For example, if the array `codes` can hold 100 values, it can be indexed using only the numbers 0 to 99
- If the value of `count` is 100, then the following reference will cause an exception to be thrown:

```
System.out.println (codes[count]);
```

- It's common to introduce *off-by-one errors* when using arrays

problem

```
for (int index=0; index <= 100; index++)
   codes[index] = index*50 + epsilon;
```


Bounds Checking

- Each array object has a public constant called `length` that stores the size of the array
- It is referenced using the array name:

```
scores.length
```

- Note that `length` holds the number of elements, not the largest index
- See `ReverseOrder.java` (page 375)
- See `LetterCount.java` (page 376)

Example: LetterCount.java (page 376)

Alternate Array Syntax

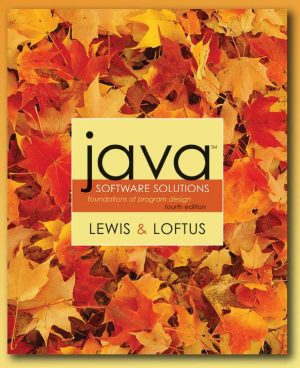
- The brackets of the array type can be associated with the element type or with the name of the array
- Therefore the following two declarations are equivalent:

```
float[] prices;
float prices[];
```

- The first format generally is more readable and should be used

Chapter 7

Section 7.3



Arrays of Objects

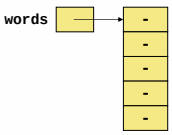
- The elements of an array can be object references
- The following declaration reserves space to store 5 references to `String` objects

```
String[] words = new String[5];
```

- It does NOT create the `String` objects themselves
- Initially an array of objects holds `null` references
- Each object stored in an array must be instantiated separately

Arrays of Objects

- The `words` array when initially declared:

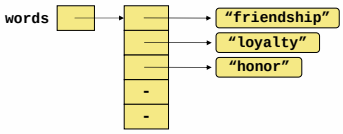


- At this point, the following reference would throw a `NullPointerException`:

```
System.out.println (words[0]);
```


Arrays of Objects

- After some `String` objects are created and stored in the array:



Arrays of Objects

- Keep in mind that `String` objects can be created using literals
- The following declaration creates an array object called `verbs` and fills it with four `String` objects created using string literals

```
String[] verbs = {"play", "work", "eat", "sleep"};
```

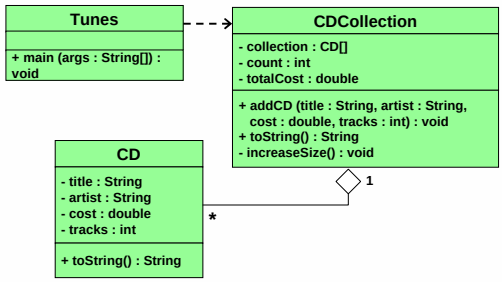

Arrays of Objects

- The following example creates an array of `Grade` objects, each with a string representation and a numeric lower bound
- See `GradeRange.java` (page 384)
- See `Grade.java` (page 385)
- Now let's look at an example that manages a collection of `CD` objects
- See `Tunes.java` (page 387)
- See `CDCollection.java` (page 388)
- See `CD.java` (page 391)

Run Examples

Arrays of Objects

- A UML diagram for the Tunes program:



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