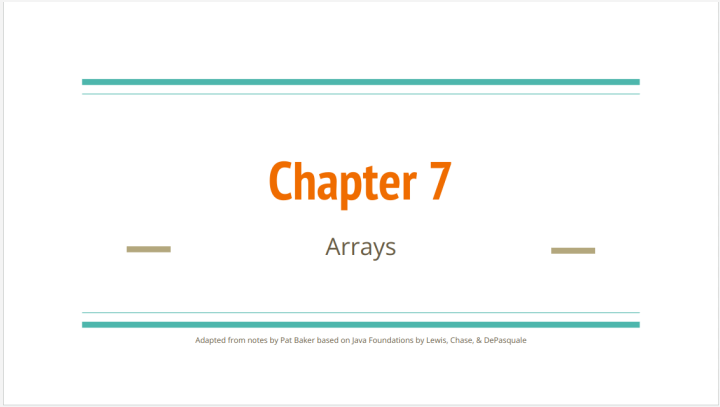
Module 6 - Arrays

General Notes

Module Materials

Instructor Slides - PDF

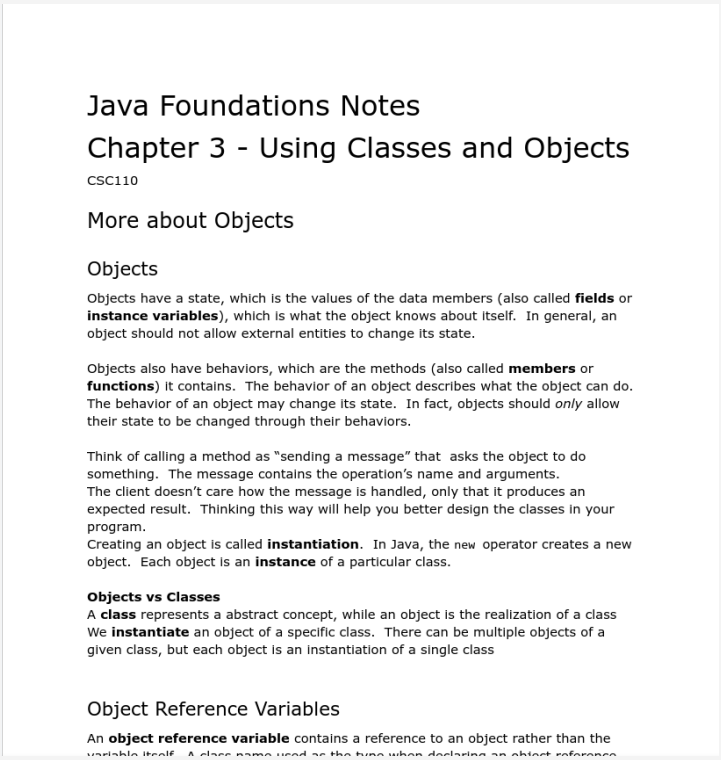
> **Instructor Slides:** PDF



Chapter Notes

Chapter 3

> Java Foundations: Chapter 3



Java Foundations Notes
Chapter 3 - Using Classes and Objects
CSC110

More about Objects

Objects

Objects have a state, which is the values of the data members (also called **fields** or **instance variables**), which is what the object knows about itself. In general, an object should not allow external entities to change its state.

Objects also have behaviors, which are the methods (also called **members** or **functions**) it contains. The behavior of an object describes what the object can do. The behavior of an object may change its state. In fact, objects should *only* allow their state to be changed through their behaviors.

Think of calling a method as "sending a message" that asks the object to do something. The message contains the operation's name and arguments.
The client doesn't care how the message is handled, only that it produces an expected result. Thinking this way will help you better design the classes in your program.
Creating an object is called **instantiation**. In Java, the `new` operator creates a new object. Each object is an **instance** of a particular class.

Objects vs Classes
A **class** represents a abstract concept, while an object is the realization of a class
We **instantiate** an object of a specific class. There can be multiple objects of a given class, but each object is an instantiation of a single class

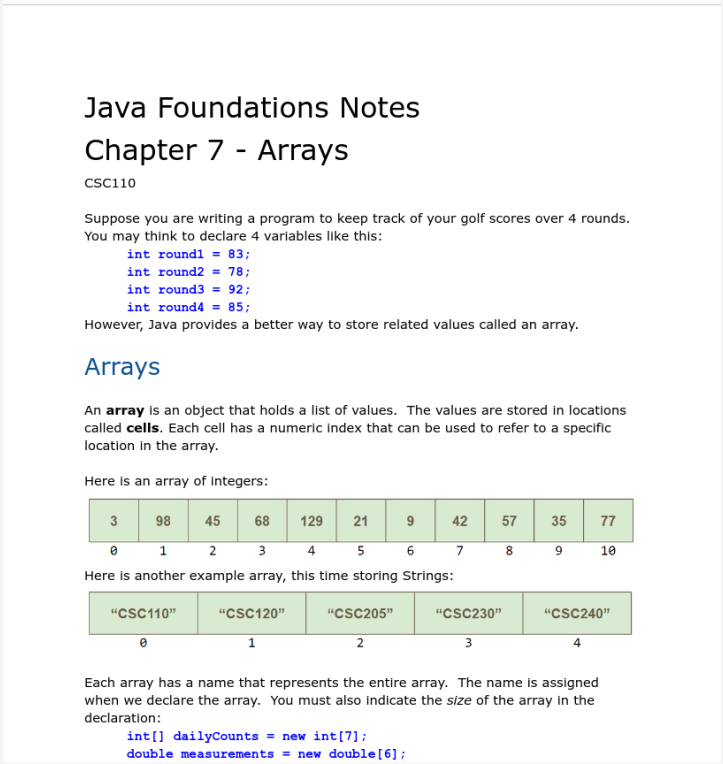
Object Reference Variables

An **object reference variable** contains a reference to an object rather than the

Chapter 7

Read part 1, stopping at 2D Arrays

> Java Foundations: Chapter 7



Java Foundations Notes
Chapter 7 - Arrays
CSC110

Suppose you are writing a program to keep track of your golf scores over 4 rounds. You may think to declare 4 variables like this:

```
int round1 = 83;
int round2 = 78;
int round3 = 92;
int round4 = 85;
```

However, Java provides a better way to store related values called an array.

Arrays

An **array** is an object that holds a list of values. The values are stored in locations called **cells**. Each cell has a numeric index that can be used to refer to a specific location in the array.

Here is an array of integers:

3	98	45	68	129	21	9	42	57	35	77
0	1	2	3	4	5	6	7	8	9	10

Here is another example array, this time storing Strings:

"CSC110"	"CSC120"	"CSC205"	"CSC230"	"CSC240"
0	1	2	3	4

Each array has a name that represents the entire array. The name is assigned when we declare the array. You must also indicate the *size* of the array in the declaration:

```
int[] dailyCounts = new int[7];
double measurements = new double[6];
```

Sample Code & Videos

GitHub Link

Web Resources

- **Oracle Docs:** Arrays
- **Video:** Introduction to Arrays Video by Author John Lewis
- **Video:** Introduction to Arrays - Part 1
- **Video:** Java Programming Tutorial 27 - Introduction to Arrays
- **Video:** Java Arrays: Finding the maximum and minimum value in an array

ZyBooks

Array Concept (General)

An **array** is a special variable having one name, but storing a list of data items, with each item being directly accessible.

- Some languages use a construct similar to an array called a **vector**. Each item in an array is known as an **element**.

In an array, each element's location number is called the **index**.

- You can access any element directly using

```
myArray[index]
myArray[2]  // Index is 2

// Syntax for other languages
myVector.at(3)
```

    - Many languages have the index start at `0`.

Array Declarations and Accessing Elements

- An **array** is an ordered list of items of a given data type.
- Each item in an array is called an **element**.
- An **array reference** variable can refer to arrays of various sizes.
- The `new` keyword creates space in memory to store the array with the specific number of elements.
- `[]` are brackets
- `{}` are braces
- The number in brackets is the **index**.
- THe first array element is at index **0**.
- Arrays are initialized with a default value or **0** if not specified.

```
public class ArrayExample {
  public static void main (String [] args) {
     int[] itemCounts = new int[3];

     itemCounts[0] = 122;
     itemCounts[1] = 119;
     itemCounts[2] = 117;

     System.out.print(itemCounts[1]);
  }
}
```

If the size of an array is known, good practice is to combine the array reference variable declaration with the array allocation.

- Do not declare and initialize separately if you know the size of the array.

Using An Expression For An Array Index

```
import java.util.Scanner;

public class OldestPeople {
   public static void main(String[] args) {
      Scanner scnr = new Scanner(System.in);
      int[] oldestPeople = new int[5];
      int nthPerson;                    // User input, Nth oldest person

      oldestPeople[0] = 122; // Died 1997 in France
      oldestPeople[1] = 119; // Died 1999 in U.S.
      oldestPeople[2] = 117; // Died 1993 in U.S.
      oldestPeople[3] = 117; // Died 1998 in Canada
      oldestPeople[4] = 116; // Died 2006 in Ecuador

      System.out.print("Enter N (1-5): ");
      nthPerson = scnr.nextInt();

      if ((nthPerson >= 1) && (nthPerson <= 5)) {
         System.out.print("The " + nthPerson + "th oldest person lived
");
         System.out.println(oldestPeople[nthPerson - 1] + " years.");
      }
   }
}
```

- Array index must be a valid `int`.

Loops and arrays

- Get an array's **length** property using `.length` after the array's name.

```
int arrayLength = myArray.length;
```

Array Initialization

- Integers and floating-point data types default to zero when initialized.
- Boolean elements default to `false` when initialized.

```
// Initializing an array
int[] myVals = {10, 10, 10, 10};
```

Iterating Through An Array Using Loops

```
// Iterating through myArray
for (i = 0; i < myArray.length; ++i) {
   // Loop body accessing myArray[i]
}
```

Common Error: Accessing Out Of Range Array Element

A common error is to try to access an array with an index that is out of the array's index range.

Multiple Arrays

Parallel arrays are when the contents at any given index in the two arrays are related:

- `letterWeights[0]` holds a weight of 1.0 ounce
- `postageCosts[0]` holds the postage cost of 1.0 ounce

Example

```
import java.util.Scanner;

public class PostageCalc {
   public static void main (String [] args) {
      Scanner scnr = new Scanner(System.in);
      // Weights in ounces
      double[] letterWeights = {1.0, 2.0, 3.0, 3.5, 4.0, 5.0, 6.0,
                                7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0};
      // Costs in cents (usps.com 2017)
      int[] postageCosts = {49, 70, 91, 112, 161, 182, 203,
                            224, 245, 266, 287, 308, 329, 350};
      double userLetterWeight;
      boolean foundWeight;
      int i;

      // Prompt user to enter letter weight
      System.out.print("Enter letter weight (in ounces): ");
      userLetterWeight = scnr.nextDouble();

      // Postage costs is based on smallest letter weight greater than
      // or equal to mailing letter weight
      foundWeight = false;

      for (i = 0; (i < letterWeights.length) && (!foundWeight); ++i) {
         if( userLetterWeight <= letterWeights[i] ) {
            foundWeight = true;
            System.out.print("Postage for USPS first class mail is ");
            System.out.print(postageCosts[i]);
            System.out.println(" cents");
         }
      }

      if( !foundWeight ) {
         System.out.println("Letter is too heavy for USPS " +
                            "first class mail.");
      }
   }
}
```

Output

```
Enter letter weight (in ounces): 3
Postage for USPS first class mail is 91 cents

...

Enter letter weight (in ounces): 9.5
Postage for USPS first class mail is 287 cents

...

Enter letter weight (in ounces): 16
Letter is too heavy for USPS first class mail.
```