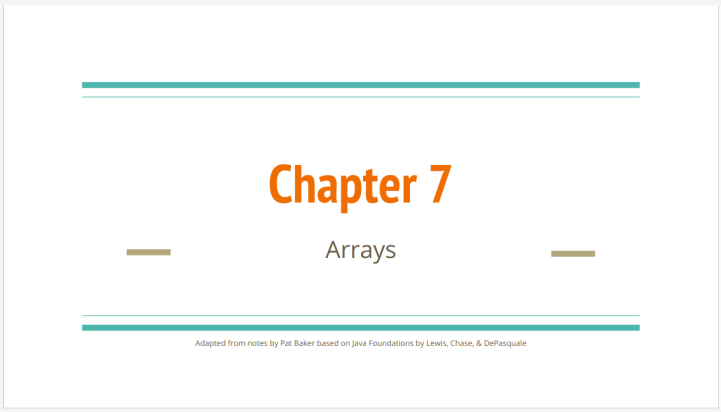
Module 7 - Arrays, Enhanced Loops, and Comparing

General Notes

Module 7 Materials

Instructor Slides

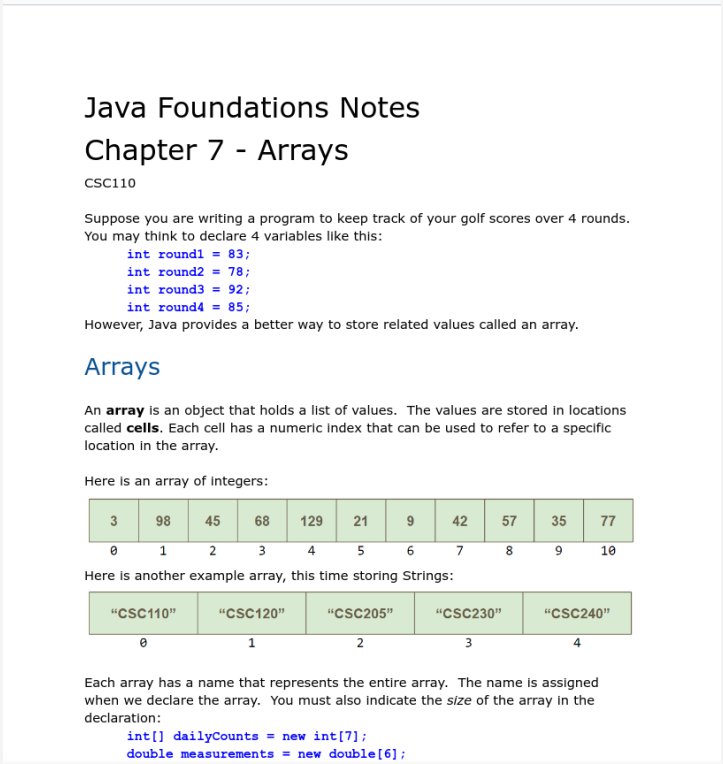
> **Instructor Slides:** PDF



Chapter 7

Read part 2

> 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

Code Examples: GitHub Link

Web Resources

- Basic Loops - For Each Loop also called an Enhanced For Loop
- 2-D Arrays - Introduction
- 2-D Arrays - Using a nested for loop to visit every element in the array
- Nested Loops & 2D Arrays

ZyBooks

Swapping Two Variables (General)

- **Swapping** two variables x and y means to assign y's value to x, and x's value to y
- A **temporary variable** is a variable used briefly to store a value.
    - A common method for swapping uses a temporary variable.

- Most swaps are actually performed between two list elements.
  - For example, reversing a list with N elements can be achieved by swapping element 1 and N, element 2 and N-1, element 3 and N-2, etc. (stopping at the middle of the list).

Modifying & Copying / Comparing Arrays

Modifying Arrays

```
import java.util.Scanner;

public class NegativeToZero {
   public static void main(String[] args) {
      Scanner scnr = new Scanner(System.in);
      final int NUM_ELEMENTS = 8;             // Number of elements
      int[] userVals = new int[NUM_ELEMENTS]; // User numbers
      int i;                                  // Loop index

      // Prompt user to input values
      System.out.println("Enter " + NUM_ELEMENTS + " integer values...");
      for (i = 0; i < userVals.length; ++i) {
         System.out.print("Value: ");
         userVals[i] = scnr.nextInt();
      }

      // Convert negatives to 0
      for (i = 0; i < userVals.length; ++i) {
         if (userVals[i] < 0) {
            userVals[i] = 0;
         }
      }

      // Print numbers
      System.out.print("New numbers: ");
      for (i = 0; i < userVals.length; ++i) {
         System.out.print(userVals[i] + " ");
      }
   }
}
```

Copying Arrays

```
import java.util.Scanner;

public class NegativeToZeroCopy {
   public static void main(String[] args) {
      Scanner scnr = new Scanner(System.in);
      final int NUM_ELEMENTS = 8;               // Number of elements
      int[] userVals = new int[NUM_ELEMENTS];   // User numbers
      int[] copiedVals = new int[NUM_ELEMENTS]; // New numbers
      int i;                                    // Loop index

      // Prompt user for input values
      System.out.println("Enter " + NUM_ELEMENTS + " integer values...");
      for (i = 0; i < userVals.length; ++i) {
         System.out.print("Value: ");
         userVals[i] = scnr.nextInt();
      }

      // Convert nums to newNums
      for (i = 0; i < userVals.length; ++i) {
         copiedVals[i] = userVals[i];
      }

      // Convert negatives to 0
      for (i = 0; i < copiedVals.length; ++i) {
         if (copiedVals[i] < 0) {
            copiedVals[i] = 0;
         }
      }

      // Print numbers
      System.out.println("\nOriginal and new values: ");
      for (i = 0; i < userVals.length; ++i) {
         System.out.println(userVals[i] + " became " + copiedVals[i]);
      }
      System.out.println();
   }
}
```

Debugging Example: Reversing an Array

```
import java.util.Scanner;

public class ArrayReverseElem {
   public static void main(String[] args) {
      Scanner scnr = new Scanner(System.in);
      final int NUM_ELEMENTS = 8;             // Number of elements
      int[] userVals = new int[NUM_ELEMENTS]; // User numbers
      int i;                                  // Loop index
      int tempVal;                            // Temp variable for
swapping

      // Prompt user to input values
      System.out.println("Enter " + NUM_ELEMENTS
              + " integer values...");
      for (i = 0; i < userVals.length; ++i) {
         System.out.print("Value: ");
         userVals[i] = scnr.nextInt();
      }

      // Reverse array's elements
      for (i = 0; i < (userVals.length / 2); ++i) {
         tempVal = userVals[i];                          // Temp for
swap
         userVals[i] = userVals[userVals.length - 1 - i]; // First part
of swap
         userVals[userVals.length - 1 - i] = tempVal;     // Swap
complete
      }

      // Print numbers
      System.out.print("\nNew values: ");
      for (i = 0; i < userVals.length; ++i) {
         System.out.print(userVals[i] + " ");
      }
   }
}
```

Two-dimensional Arrays

```
double[ ] [ ] rainfall = new double [ 4 ] [ 7 ];
                                  // [row] [col]
int numberOfRows = rainfall.length;
int numberOfColumns = rainfall[0].length;

// General Syntax
for (int row = 0; row < numberOfRows; row++){
    for (int col = 0; col < numberOfColumns; col++){
        rainfall[row][col] = 5.0;
     }
   }

// Initializing a 2D array
int[][] numVals = { {22, 44, 66}, {97, 98, 99} };

// Use multiple lines to make rows more visible
int[][] numVals = {
      {22, 44, 66}, // Row 0
      {97, 98, 99}  // Row 1
};
```

Enhanced for loop: Arrays

The **enhanced for loop** is also called a **for-each loop**.

- The enhanced for loop declares a new **loop variable**, whose scope is limited to the for loop, that will be assigned with each successive element of an array.

Limitations of the for-each loop:

- **for-each loops** are not appropriate when you want to modify the array.
- **for-each loops** do not keep track of index. So we can not obtain array index using **for-each loop**.
- **for-each loops** only iterate forward over the array in single steps

```
// Syntax
for (type var : array)
{
    statements using var;
}
```

- Compared to a regular for loop, an enhanced for loop decreases the amount of code needed to iterate through arrays, thus enhancing code readability and clearly demonstrating the loop's purpose.
- An enhanced for loop also prevents a programmer from writing code that incorrectly accesses elements outside the array's range.

Common Error: Modifying The Loop Variable

A common error is modifying the loop variable in an attempt to modify the array's elements.

The loop variable is a copy of the current array element in the iteration. Thus, assigning the loop variable with a value only modifies the loop variable and does not change the array element.