Flow of Control: Loops

Chapter 4
Part 6 – Nested Loops
Objectives

• Design a loop
• Use `while`, `do`, and `for` in a program
• Use the `for-each` with enumerations
• Use assertion checks
• Use repetition in a graphics program
• Use `drawString` to display text in a graphics program
Nested Loops

- The body of a loop can contain any kind of statements, **including another loop**
Nested Loops

• The body of a loop can contain any kind of statements, including another loop

• Exercise
  ▪ Write the code snippet that crates the following output

  1  2  3  4  5  6  7  8  9  10
Nested Loops

• The body of a loop can contain any kind of statements, **including another loop**

• Exercise
  - Write the code snippet that creates the following output:
    
    1  2  3  4  5  6  7  8  9  10

• Solution:
  ```java
  for (int i = 0; i <= 10; ++i)
  {
      System.out.print(i + " ");
  }
  System.out.println(" ");
  ```
Nested Loops

• Exercise
  - Write the code snippet that creates the following output

* * * * * *
Nested Loops

• Exercise
  ▪ Write the code snippet that creates the following output

• Solution:

```java
for (int i = 0; i <= 5; ++i)
    System.out.print("*" + " ");
```
Nested Loops

• Exercise
  - Write the code snippet that creates the following output

```
  *
  * *
  * * *
  * * * *
  * * * * *
```

Nested Loops

• Exercise
  ▪ Write the code snippet that creates the following output

• Solution:

```java
for (int i = 0; i <= 4; ++i)
{
    for (int j = 0; j <= i; ++j)
    {
        System.out.print("*");
    }
    System.out.println('');
}
```

Nested Loops

• Exercise
  ▪ Write the code snippet that creates the following output

• Solution:

```java
for (int i = 0; i <= 10; ++i)
    System.out.print(i + " ");
System.out.println("\n");
```
Nested Loops

• Exercise
  ▪ What is the output of the following code snippet?

```java
for (int i = 0; i <= 3; ++i)
{
    for (int j = 4; j > 0; --j)
    {
        System.out.print((i+j)+" ");
    }
    System.out.println(" ");
}
```
Nested Loops

• Exercise
  ▪ What is the output of the following code snippet?

• Solution:

```java
for (int i = 0; i <= 3; ++i)
{
    for (int j = 4; j >0; --j)
    {
        System.out.print((i+j)+" ");
    }
    System.out.println(" ");
}
```
Nested Loops Example

**Sample Screen Output**

This program computes the average of a list of (nonnegative) exam scores. Enter all the scores to be averaged. Enter a negative number after you have entered all the scores.

100
90
100
90
-1

The average is 95.0
Want to average another exam?
Yes or no.

Yes

Enter all the scores to be averaged. Enter a negative number after you have entered all the scores.

90
70
80
-1

The average is 80.0
Want to average another exam?
Yes or no.

No

---

**Listing 4.4 Nested Loops**

```java
import java.util.Scanner;

/**
 * Computes the average of a list of (nonnegative) exam scores. Repeats computation for more exams until the user says to stop.
 */
public class ExamAverager {
    public static void main(String[] args) {
        System.out.println("This program computes the average of");
        System.out.println("a list of (nonnegative) exam scores.");
        double sum;
        int numberOfStudents;
        double next;
        String answer;
        Scanner keyboard = new Scanner(System.in);
        do {
            System.out.println();
            System.out.println("Enter all the scores to be averaged.");
            System.out.println("Enter a negative number after you have entered all the scores.");
            90
            70
            80
            -1
            The average is 80.0
            Want to average another exam?
            Enter yes or no.
            no
        } while (answer.equalsIgnoreCase("yes"));
    }
}
```
Nested Loops Notes

• In the previous example
  - The average score was computed using a `while` loop
  - This `while` loop was placed inside a `do-while` loop so the process could be repeated for other sets of exam scores
Summary

A loop is a programming construct that repeats an action.

Java has the `while`, the `do-while`, and the `for` statements.

The `while` and `do-while` repeat the loop while a condition is true.

The logic of a `for` statement is identical to the `while`
Summary

- Loops may be ended using a sentinel value or a boolean value.
- Typical loop bugs include infinite loops or loops which are off by 1 iteration.
- Variables may be traced by including temporary output statements or a debugging utility.
- The `assert` statement can be used to check conditions at run time.
- Use `drawString` to display text in an applet.