Fundamentals of Java

Session: 4

Decision-Making Constructs

Objectives

- Identify the need for decision-making statements
- List the different types of decision-making statements
- Explain the if statement
- Explain the various forms of if statement
- Explain the switch-case statement
- Explain the use of strings and enumeration in the switch-case statement
- Compare the if-else and switch-case statement

Introduction

- A Java program consists of a set of statements which are executed sequentially in the order in which they appear.
- The change in the flow of statements is achieved by using different **control flow statements**.
- Three categories of control flow statements supported by Java programming language are as follows:

Conditional Statements	• These types of statements are also referred to as decision-making statements.
Iteration Statements	• These types of statements are also referred to as looping constructs.
Branching Statements	• These types of statements are referred to as jump statements.

Decision-making Statements

- Enable us to change the flow of execution of a Java program.
- Evaluates a condition and based on the result of evaluation, a statement or a sequence of statements is executed.
- Different types of decision-making statements supported by Java are as follows:

`if` Statement

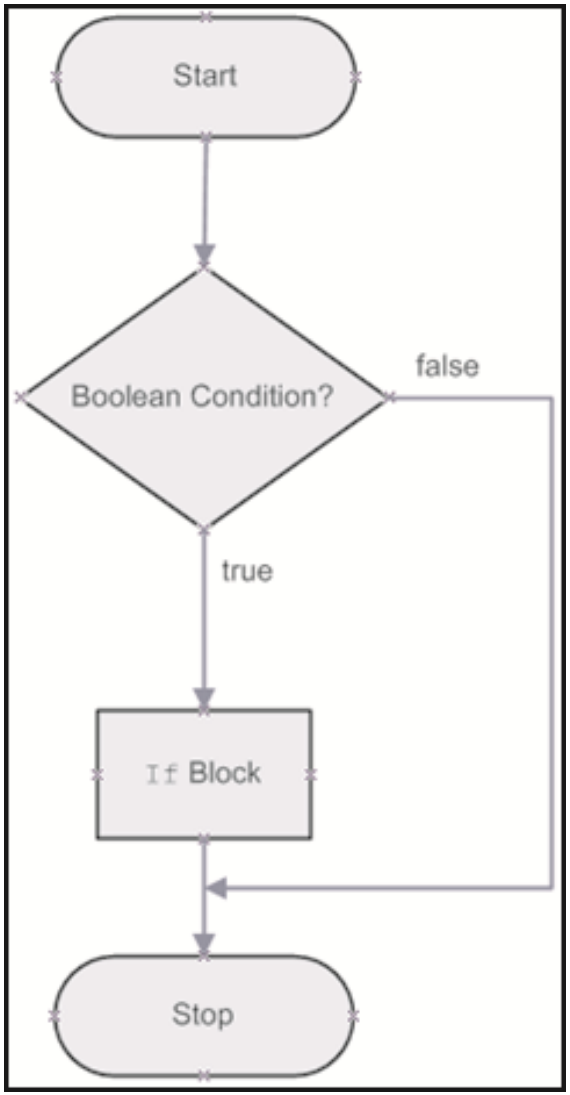
`Switch-case` Statement

‘if’ Statement 1-5

- It is the most basic form of decision-making statement.
- It evaluates a given condition and based on the result of evaluation executes a certain section of code.
- If the condition evaluates to `true`, then the statements present within the `if` block gets executed.
- If the condition evaluates to `false`, the control is transferred directly to the statement outside the `if` block.

'if' Statement 2-5

- Following figure shows the flow of execution for the `if` statement:



'if' Statement 3-5

- The syntax for using the `if` statement is as follows:

Syntax

```
if (condition) {

    // one or more statements;

}
```

where,

`condition`: Is the boolean expression.

`statements`: Are instructions/statements enclosed in curly braces. These statements are executed when the boolean expression evaluates to `true`.

'if' Statement 4-5

- Following code snippet demonstrates the code that performs conditional check on the value of a variable:

```
public class CheckNumberValue {
/**
 * @param args the command line arguments
 */
 public static void main(String[] args) {
  int first = 400, second = 700, result;
  result = first + second;

 // Evaluates the value of result variable
    if (result > 1000) {
        second = second + 100;
    }
  System.out.println("The value of second is " + second);
 }
}
```

  - The program tests the value of the variable, **`result`** and accordingly calculates value for the variable, **`second`**.
  - If the value of **`result`** is greater than 1000, then the value of the variable **`second`** is incremented by 100.

'if' Statement 5-5

- If the evaluation of condition is `false`, the value of the variable **`second`** is not incremented.
- Finally, the value of the variable **`second`** gets printed on the console.

- Following figure shows the output of the code:

```
Output - Session4 (run)
run:
The value of second is 800
BUILD SUCCESSFUL (total time: 0 seconds)
```

- If there is only a single action statement within the body of the `if` block, then use of opening and closing curly braces is optional.

'if-else' Statement 1-3

- Sometimes, it is required to define a block of statements to be executed when a condition evaluates to `false`.
- This is done by using the `if-else` statement.
- `if-else` Statement:
  - Begins with the `if` block followed by the `else` block.
  - `else` block specifies a block of statements that are to be executed when a condition evaluates to `false`.
- The syntax for using the `if-else` statement is as follows:

Syntax

```
if (condition) {
    // one or more statements;
}
else {
    // one or more statements;
}
```

'if-else' Statement 2-3

- Following code snippet demonstrates the code that checks whether a number is even or odd:

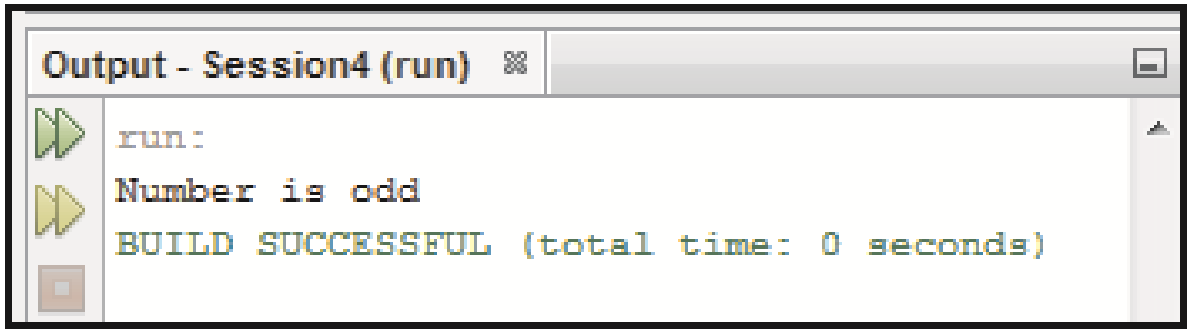
```
public class Number_Division {

 /**
  * @param args the command line arguments
  */
  public static void main(String[] args) {
    int number = 11, remainder;

    // % operator to return the remainder of the division
    remainder = number % 2;
    if (remainder == 0) {
        System.out.println("Number is even");
    } else {
        System.out.println("Number is odd");
    }
  }
}
```

  - In the code, the variable, **`number`** is divided by 2 to obtain the remainder of the division.

'if-else' Statement 3-3

- The % (modulus) operator which returns the remainder after performing the division.
- If the remainder is 0, the message **`Number is even`** is printed. Otherwise, the message **`Number is odd`** is printed.

- Following figure shows the output of the code:



Nested-if Statement 1-4

- An `if` statement can also be used within another `if` statement forming a nested-if.
- A nested-if statement is an `if` statement that is the target of another `if` or `else` statement.
- The syntax to use the nested-if statements is as follows:

Syntax

```
if(condition) {

     if(condition)
       true-block statement(s);
     else
       false-block statement(s);
     }

else {
       false-block statement(s);
}
```

Nested-if Statement 2-4

- Following code snippet checks whether a number is divisible by 3 as well as 5:

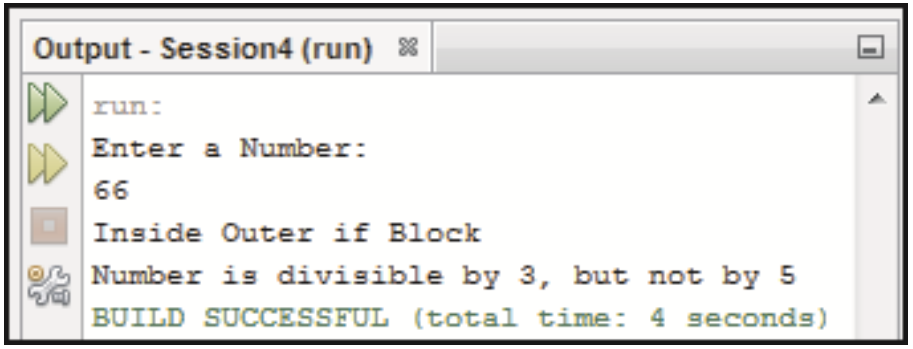
```
import java.util.*;
public class NumberDivisibility {
  /**
   * @param args the command line arguments
   */
   public static void main(String[] args) {
     // Scanner class is used to accept values from the user
        Scanner input = new Scanner(System.in);
        System.out.println("Enter a Number: ");
        int num = input.nextInt();

     // Checks whether a number is divisible by 3
        if (num % 3 == 0) {
              System.out.println("Inside Outer if Block");

        // Inner if statement checks if number is divisible by 5
          if (num % 5 == 0) {
            System.out.println("Number is divisible by 3 and 5");
          } else {
           System.out.println("Number is divisible by 3, but not by 5");
          } // End of inner if-else statement
```

Nested-if Statement 3-4

```
        } else {
           System.out.println("Number is not divisible by 3");
        } // End of outer if-else statement
   }
}
```

- The code declares a variable **num** to store an integer value accepted from the user.
- Initially, the outer `if` statement is evaluated. If it evaluate to:
  - `false`, then the inner `if-else` statement is skipped and the final `else` block is executed.
  - `true`, then its body containing the inner `if-else` statement is evaluated.

- Following figure shows the output of the code:



Nested-if Statement 4-4

- The important points to remember about nested-if statements are as follows:

An `else` statement should always refer to the nearest `if` statement.

The `if` statement must be within the same block as the `else` and it should not be already associated with some other `else` statement.

‘if-else-if’ Ladder 1-5

- The multiple `if` construct is known as the `if-else-if` ladder.
- The conditions are evaluated sequentially starting from the top of the ladder and moving downwards.
- When a condition controlling the `if` statement is evaluated as `true`, then the associated statements associated are executed and all other `else-if` statements are bypassed.
- If none of the condition is `true`, then the final `else` statement also referred as default statement is executed.

'if-else-if' Ladder 2-5

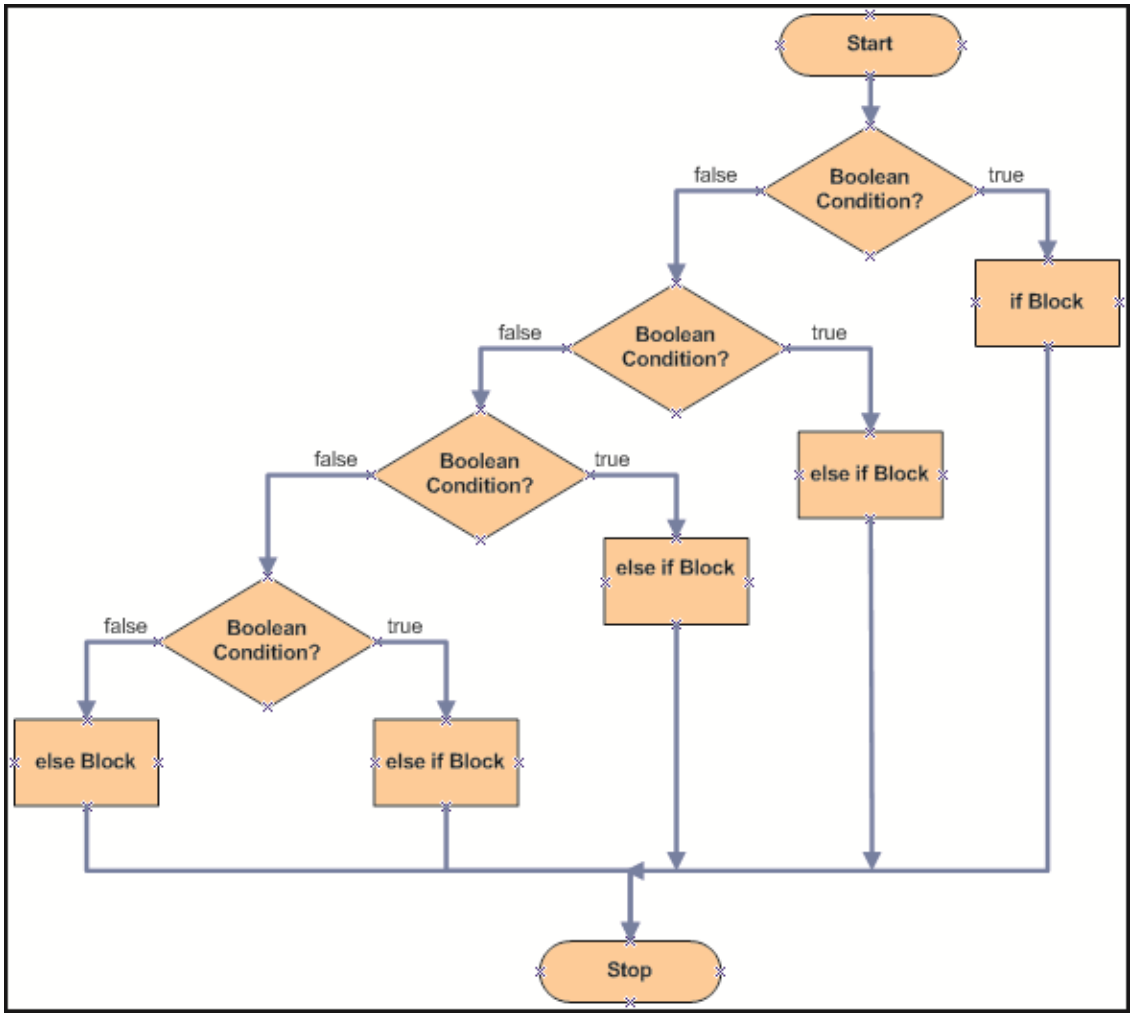
- The syntax for using the `if-else-if` statement is as follows:

Syntax

```
if(condition) {
    // one or more statements
}

else if (condition) {
    // one or more statements
}

else {
    // one or more statements
}
```

‘if-else-if’ Ladder 3-5

- Following figure shows the flow of execution for the `if-else-if` ladder:



‘if-else-if’ Ladder 4-5

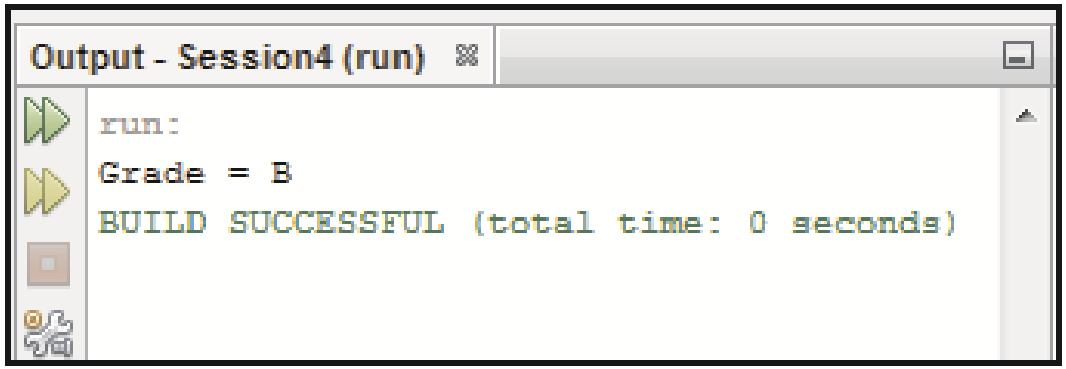
- Following code snippet checks the total marks and prints the appropriate grade:

```
public class CheckMarks {
  /**
   * @param args the command line arguments
   */
   public static void main(String[] args) {
     int totalMarks = 59;
      /* Tests the value of totalMarks and accordingly transfers
       * control to the else if statement
       */
      if (totalMarks >= 90) {
         System.out.println(“Grade = A+”);
      } else if (totalMarks >= 60) {
         System.out.println(“Grade = A”);
      } else if (totalMarks >= 40) {
         System.out.println(“Grade = B”);
      } else if (totalMarks >= 30) {
         System.out.println(“Grade = C”);
      } else {
         System.out.println(“Fail”);
      }
  }
}
```

‘if-else-if’ Ladder 5-5

- If the code satisfies a given condition, then:
  - The statements within that `else if` condition are executed.
  - After execution of the statements, the control breaks.
  - Remaining `if` conditions are bypassed for evaluation.
- If none of the condition is satisfied, then:
  - The final `else` statement, also known as the default `else` statement is executed.

- Following figure shows the output of the code:



‘switch-case’ Statement 1-11

- Alternative for too many `if` statements representing multiple selection constructs.
- Contains a variable as an expression whose value is compared against different values.
- Results in better performance.
- Can have a number of possible execution paths depending on the value of expression provided with the `switch` statement.
- Can evaluate different primitive data types, such as `byte`, `short`, `int`, and `char`.

‘switch-case’ Statement 2-11

Enhancements to `switch-case` statement in Java SE 7

- Supports the use of strings in the `switch-case` statement.
- `String` variable can be passed as an expression for the `switch` statement.
- Supports use of objects from classes present in the Java API.
- The classes whose objects can be used are `Character`, `Byte`, `Short`, and `Integer`.
- Supports the use of enumerated types as expression.

'switch-case' Statement 3-11

- The syntax for using the `switch-case` statement is as follows:

Syntax

```
switch (<expression>) {
 case value1:
        // statement sequence
           break;
 case value2:
        // statement sequence
           break;
 . . .
 . . .
 . . .
 case valueN:
        // statement sequence
           break;
 default:
        // default statement sequence
}
```

where,

`switch`: The `switch` keyword is followed by an expression enclosed in parentheses.

‘switch-case’ Statement 4-11

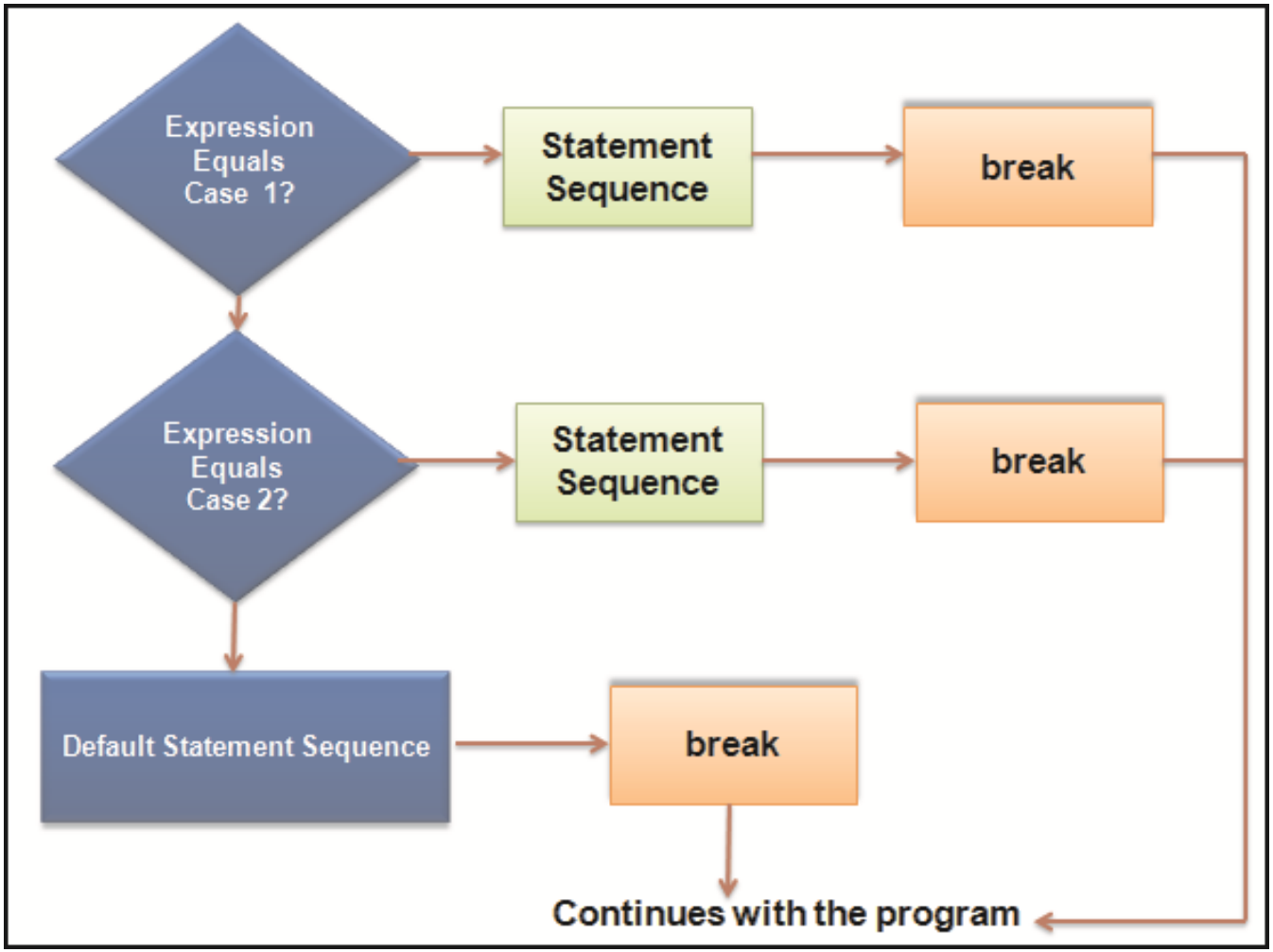
`Case`: The `case` keyword is followed by a constant and a colon. Each case value is a unique literal.

`default`: If no case value matches the switch expression value, execution continues at the `default` clause.

`break`: The `break` statement is used inside the `switch-case` statement to terminate the execution of the statement sequence. It is optional. If there is no `break` statement, execution flows sequentially into the next cases.

'switch-case' Statement 5-11

- Following figure shows the flow of execution for the `switch-case` statement:



‘switch-case’ Statement 6-11

The value of the expression specified with the `switch` statement is compared with each case constant value.

If any `case` value matches, the corresponding statements in that `case` are executed.

When the `break` statement is encountered, it terminates the `switch-case` block and control switches to the statements following the block.

The `break` statement must be provided as without it, even after the matching case is executed; all other cases following the matching case are also executed.

If there is no matching case, then the `default` case is executed.

‘switch-case’ Statement 7-11

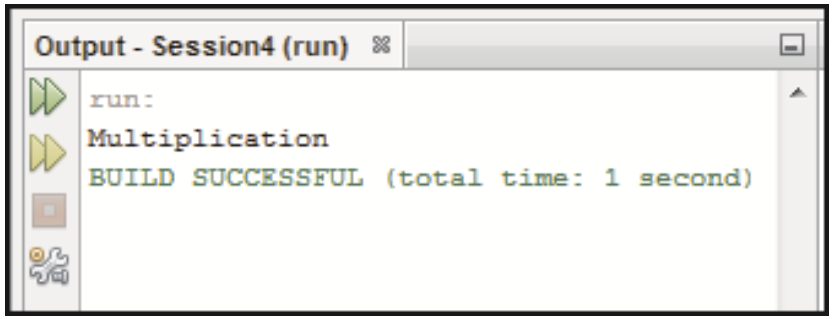
- Following code snippet demonstrates the use of the `switch-case` statement:

```
public class TestNumericOperation {

  /**
   * @param args the command line arguments
   */
   public static void main(String[] args) {

    // Declares and initializes the variable
       int choice = 3;

    // switch expression value is matched with each case
       switch (choice) {
        case 1:
            System.out.println(“Addition”);
            break;
        case 2:
            System.out.println(“Subtraction”);
            break;
        case 3:
            System.out.println(“Multiplication”);
            break;
```

‘switch-case’ Statement 8-11

```
        case 4:
            System.out.println("Division");
            break;
        default:
            System.out.println("Invalid Choice");
        } // End of switch-case statement
    }
}
```

- Value of the expression, **`choice`** is compared with the literal value in each of the `case` statement.
- Here, `case 3` is executed, as its value is matching with the expression.
- The control moves out of the `switch-case`, due to the presence of the `break` statement.
- Following figure shows the output of the code:



'switch-case' Statement 9-11

- Sometimes, it is required to have multiple `case` statements to be executed without a `break` statement.
- Following code snippet demonstrates the use of multiple case statements with no `break` statement:

```
public class NumberOfDays {
  /**
   * @param args the command line arguments
   */
   public static void main(String[] args) {

     int month = 5;
     int year = 2001;
     int numDays = 0;

     // Cases are executed until a break statement is encountered
        switch (month) {
         case 1:
         case 3:
         case 5:
         case 7:
```

‘switch-case’ Statement 10-11

```
        case 8:
        case 10:
        case 12:
                numDays = 31;
                break;
        case 4:
        case 6:
        case 9:
        case 11:
                numDays = 30;
                break;
        case 2:
                if (year % 4 == 0) {
                  numDays = 29;
                } else {
                  numDays = 28;
                }
                break;
        default:
                System.out.println(“Invalid Month”);
        } // End of switch-case statement
        System.out.println(“Month: “ + month);
        System.out.println(“Number of Days: “ + numDays);
    }
}
```

‘switch-case’ Statement 11-11

- The value of expression, **`month`** is compared through each case, till a `break` statement or end of the `switch-case` block is encountered.

- Following figure shows the output of the code:

```
Output - Session4 (run)
run:
Month: 5
Number of Days: 31
BUILD SUCCESSFUL (total time: 0 seconds)
```

String-based 'switch-case' Statement 1-4

- Java SE 7 supports the use of strings in the `switch-case` statement.
- A `String` is not a primitive data type, but an object in Java.
- To use strings for comparison, a `String` object is passed as an expression in the `switch-case` statement.
- Following code snippet demonstrates the use of strings in the `switch-case` statement:

```
public class DayofWeek {

  /**
   * @param args the command line arguments
   */
   public static void main(String[] args) {
     String day = "Monday";

     // switch statement contains an expression of type String

      switch (day) {
         case "Sunday":
                        System.out.println("First day of the Week");
                        break;
```

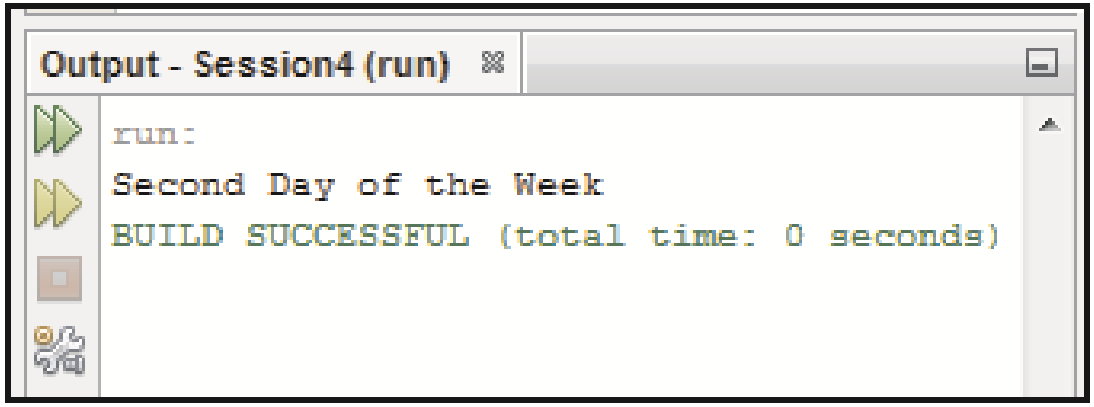
String-based 'switch-case' Statement 2-4

```
        case "Monday":
                    System.out.println("Second Day of the Week");
                    break;
        case "Tuesday":
                    System.out.println("Third Day of the Week");
                    break;
        case "Wednesday":
                    System.out.println("Fourth Day of the Week");
                    break;
        case "Thursday":
                    System.out.println("Fifth Day of the Week");
                    break;
        case "Friday":
                    System.out.println("Sixth Day of the Week");
                    break;
        case "Saturday":
                    System.out.println("Seventh Day of the Week");
                    break;
        default:
                   System.out.println("Invalid Day");
        }// End of switch-case statement
    }
}
```

String-based 'switch-case' Statement 3-4

- The statement **`String day="Monday"`** creates an object named day of type `String` and initializes it.
- The object is passed as an expression to the `switch` statement.
- The value of this expression, that is "`Monday`", is compared with the value of each `case` statement.
- If no matching statement is found, then the statement associated with the default clause is executed.

- Following figure shows the output of the code:



String-based 'switch-case' Statement 4-4

- Following points are to be considered while using strings with the `switch-case` statement:

Null Values

- A runtime exception is generated when a `String` variable is assigned a `null` value and is passed as an expression to the `switch` statement.

Case-sensitive values

- The value of `String` variable that is matched with the case literals is case sensitive.
- Example: a `String` value "**`Monday`**" when matched with the case labeled "**`MONDAY`**" **:**, then it will not be treated as a matched value.

Enumeration-based 'switch-case' Statement 1-3

- The `switch-case` statement supports the use of an enumeration (`enum`) value in the expression.
- The constraint with an `enum` expression is that:
  - All case constants must belong to the same `enum` variable used with the `switch` statement.
- Following code snippet demonstrates the use of enumerations in the `switch-case` statement:

```
public class TestSwitchEnumeration {

  /**
   * An enumeration of Cards Suite
   */

   enum Cards {
       Spade, Heart, Diamond, Club
   }
   /**
    * @param args the command line arguments
    */
     public static void main(String[] args) {
      Cards card = Cards.Diamond;
```

Enumeration-based 'switch-case' Statement 2-3

```
        // enum variable is used to control a switch statement
          switch (card) {
           case Spade:
                      System.out.println("SPADE");
                      break;
           case Heart:
                      System.out.println("HEART");
                      break;
           case Diamond:
                      System.out.println("DIAMOND");
                      break;
           case Club:
                      System.out.println("CLUB");
                      break;
           } // End of switch-case statement
   }
}
```

- The `enum`, **`card`** is passed as an expression to the `switch` statement.
- Each `case` statement has an enumeration constant associated with it and does not require it to be qualified by the enumeration name.

Enumeration-based 'switch-case' Statement 3-3

- Following figure shows the output of the code:

```
Output - Session4 (run)
run:
DIAMOND
BUILD SUCCESSFUL (total time: 0 seconds)
```

Nested 'switch-case' Statement 1-4

- A `switch-case` statement can be used as a part of another `switch-case` statement . This is referred to as nested `switch-case` statements.
- Following code snippet demonstrates the use of nested `switch-case` statements:

```
public class Greeting {
  /**
   * @param args the command line arguments
   */
   public static void main(String[] args) {
   // String declaration
      String day = "Monday";
      String hour = "am";

   // Outer switch statement
      switch (day) {
       case "Sunday":
                  System.out.println("Sunday is a Holiday...");
                     // Inner switch statement
                        switch (hour) {
```

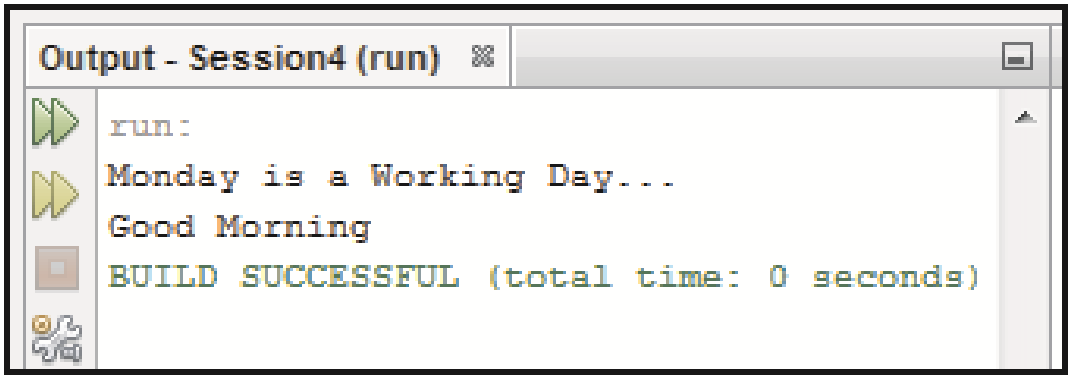
Nested 'switch-case' Statement 2-4

```
                                case "am":
                                     System.out.println("Good Morning");
                                     break;
                                case "pm":
                                     System.out.println("Good Evening");
                                     break;
                                } // End of inner switch-case statement
                    break; // Terminates the outer case statement

     case "Monday":
                    System.out.println("Monday is a Working Day...");
                     switch (hour) {
                                case "am":
                                     System.out.println("Good Morning");
                                     break;
                                case "pm":
                                     System.out.println("Good Evening");
                                     break;
                                } // End of inner switch-case statement
                    break;
      default:
                    System.out.println("Invalid Day");
      } // End of the outer switch-case statement
  }
}
```

Nested 'switch-case' Statement 3-4

- The variable, **`day`** is used as an expression with the outer `switch` statement.
- If the value of **`day`** variable matches with "**`Sunday`**" or "**`Monday`**", then the inner `switch-case` statement is executed.
- The inner `switch` statement compares the value of **`hour`** variable with case constants "**`am`**" or "**`pm`**".

- Following figure shows the output of the code:



Nested 'switch-case' Statement 4-4

- The three important features of `switch-case` statements are as follows:

The `switch-case` statement differs from the `if` statement, as it can only test for equality.

No two case constants in the same `switch` statement can have identical values, except the nested `switch-case` statements.

A `switch` statement is more efficient and executes faster than a set of `nested-if` statements.

Comparison Between if and switch-case Statement

- Following table lists the differences between `if` and `switch-case` statement:

if	switch-case
Each `if` statement has its own logical expression to be evaluated as `true` or `false`	Each case refers back to the original value of the expression in the `switch` statement
The variables in the expression may evaluate to a value of any type	The expression must evaluate to a `byte`, `short`, `char`, `int`, or `String`
Only one of the blocks of code is executed	If the `break` statement is omitted, the execution will continue into the next block

Summary

- A Java program is a set of statements, which are executed sequentially in the order in which they appear.
- The three categories of control flow statements supported by Java programming language include: conditional, iteration, and branching statements.
- The if statement is the most basic decision-making statement that evaluates a given condition and based on result of evaluation executes a certain section of code.
- The if-else statement defines a block of statements to be executed when a condition is evaluated to false.
- The multiple if construct is known as the if-else-if ladder with conditions evaluated sequentially from the top of the ladder.
- The switch-case statement can be used as an alternative approach for multiple selections. It is used when a variable needs to be compared against different values. Java SE 7 supports strings and enumerations in the switch-case statement.
- A switch statement can also be used as a part of another switch statement. This is known as nested switch-case statements.