CSC 125
Object Oriented Programming

Ch03_Flow Control

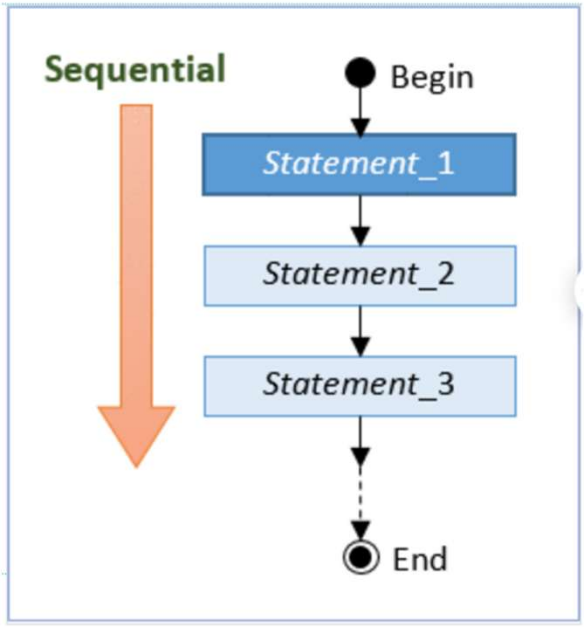
Dr. Fadi Alzhouri

Flow Control

- Flow control determines the order in which statements execute in a program.
- Enables complex logic through conditional execution, loops, and branching.
- There are four basic flow control constructs:
  - Sequential
  - conditional (or decision)
  - loop (or iteration)
  - and branching

Sequential Flow Control

- Sequential flow is the most common and straightforward, where instructions are executed in the order that they appear (from top to bottom in a sequential manner).



Conditional Statements

- There are a few types of conditionals:
  - if-
  - if-else
  - switch-case-default
  - and conditional expression.
- Allows you to execute a statement (or a block of statements) conditionally, based on whether a specified condition evaluates to true or false.

If statement

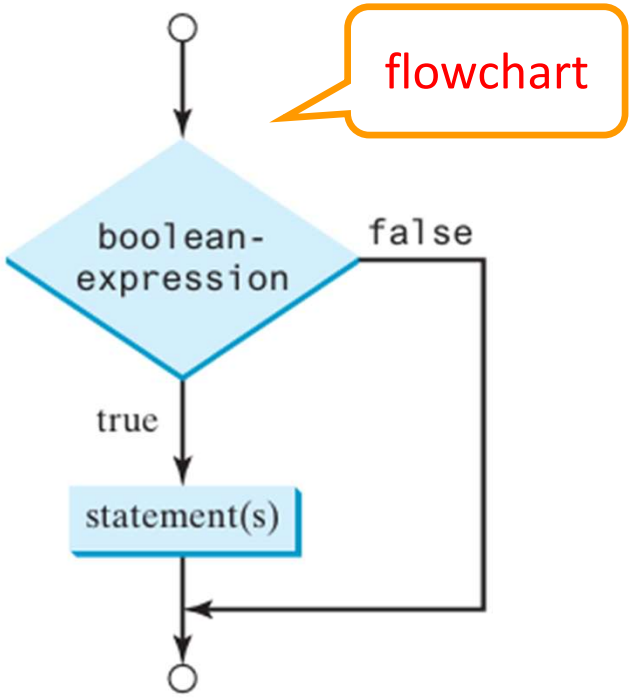
- An IF statement allows you to skip the execution of a code block if the condition evaluates to false.
- The syntax :

```
if (boolean-expression)
    statement;
```

or

```
if (boolean-expression) {
    statement(s);
}
```

Always use this style



- The flowchart illustrates how Java executes the syntax of an if statement.

If statement (cont.)

- Example: To check that the denominator is greater than zero, you can use the if statement.

```
/**********************************************************
Conditional statements
Author: Dr. Fadi Alzhouri
Example 11: If statement
**********************************************************/

public class IfStatement
{
    public static void main(String[] args) {
        int numerator = 12;
        int denominator = 4;
        if(denominator != 0)
            System.out.println( numerator + "/" + denominator +
            " = " + numerator/denominator);
    }
}
```

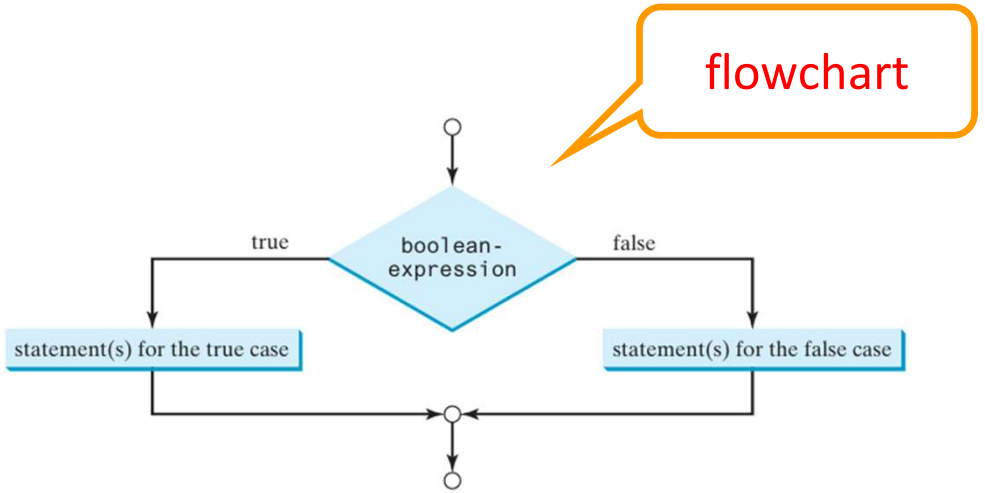
True statement

```
12/4 = 3
```

If-else Statement

- The if statement can be extended with an else clause to provide an alternative code block that executes if the condition is false.
- Syntax:

```
if (boolean-expression) {
    statement(s)-for-the-true-case;
}
else {
    statement(s)-for-the-false-case;
}
```



- An `if-else` statement decides the execution path based on whether the condition is true or false.

If-else Statement (cont.)

- In the previous example, nothing is displayed if the condition is false.

```
/**********************************************************
Conditional statements
Author: Dr. Fadi Alzhouri
Example 11: If statement
**********************************************************/

public class IfStatement
{
    public static void main(String[] args) {
        int numerator = 12;
        int denominator = 0;
        if(denominator != 0)
            System.out.println( numerator + "/" + denominator +
            " = " + numerator/denominator);
    }
}
```

output

If-else Statement (cont.)

- It is good to inform the user that it is not allowed to divide by zero.

```
/*************************************************************
Conditional statements
Author: Dr. Fadi Alzhouri
Example 12: If-else statement
*************************************************************/

public class IfElse
{
    public static void main(String[] args) {
        int numerator = 12;
        int denominator = 0;
        if (denominator > 0){
            System.out.println( numerator + "/" + denominator +
            " = " + numerator/denominator);
        }
        else{
            System.out.println("It is not allowed to divide by 0");
        }
    }
}
```

True block

False block

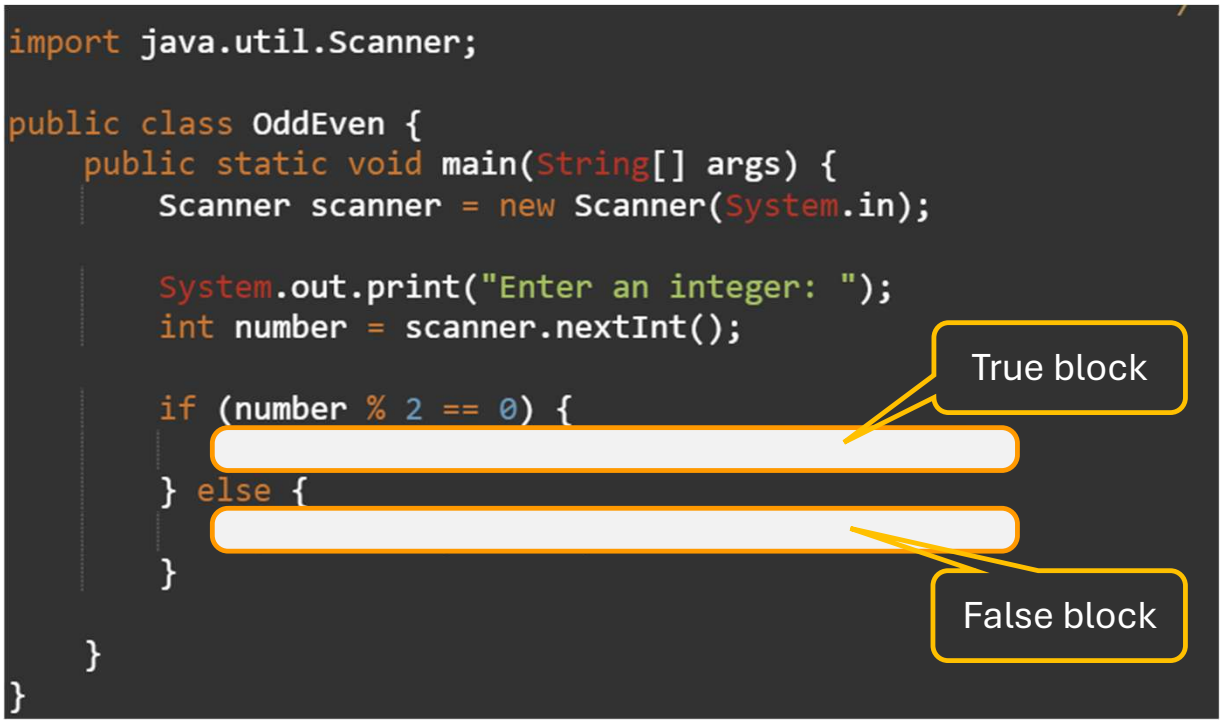
```
It is not allowed to divide by 0
```

Exercise

- Write a Java program that prompts the user to enter an integer. Use an if-else statement to determine if the entered number is odd or even and then print the result to the console.

Exercise (cont.)

- Write a Java program that prompts the user to enter an integer. Use an if-else statement to determine if the entered number is odd or even and then print the result to the console.



Exercise (cont.)

- Write a Java program that prompts the user to enter an integer. Use an if-else statement to determine if the entered number is odd or even and then print the result to the console.

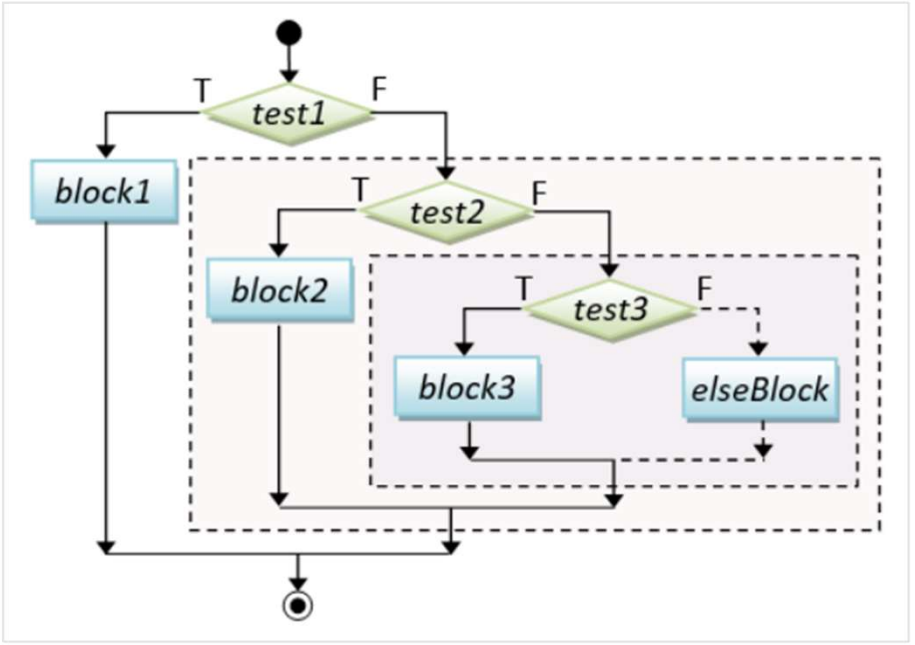
```java
import java.util.Scanner;

public class OddEven {
    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);

        System.out.print("Enter an integer: ");
        int number = scanner.nextInt();

        if (number % 2 == 0) {
            System.out.println(number + " is even.");
        } else {
            System.out.println(number + " is odd.");
        }

    }
}
```

```
7 is odd.
```

Nested-if Statement

- An if statement can be inside another if statement to form a nested if statement.

```
public class Main
{
    public static void main(String[] args) {

        if ( booleanTest1 ) {
            block1;
        } else if ( booleanTest2 ) {
                block2;
            } else if (booleanTest3) {
                    block3;
                } else if ( booleanTest4 ) {
                            ......
                        } else {
                                elseBlock;
                        }
                }
            }
        }
    }
}
```



Nested-if Statement (cont.)

- There are two ways of writing nested-if:

```
if (score >= 90.0)
  System.out.print("A");
else
  if (score >= 80.0)
    System.out.print("B");
  else
    if (score >= 70.0)
      System.out.print("C");
    else
      if (score >= 60.0)
        System.out.print("D");
      else
        System.out.print("F");
```

(a)

Equivalent

This is better

```
if (score >= 90.0)
  System.out.print("A");
else if (score >= 80.0)
  System.out.print("B");
else if (score >= 70.0)
  System.out.print("C");
else if (score >= 60.0)
  System.out.print("D");
else
  System.out.print("F");
```

(b)

- The blocks are exclusive in a nested-if statement; only one of the blocks will be executed.

Exercise

- Write a program to do the following:

if a student's grade is greater than or equal to 90
Print "A"

else if a student's grade is greater than or equal to 80
Print "B"
else if a student's grade is greater than or equal to 70
Print "C"
else if a student's grade is greater than or equal to 60
Print "D"
else
Print "F"

Exercise (cont.)

```java
/*************************************************************
Conditional statements
Author: Dr. Fadi Alzhouri
Example 14: Nested If-else statements
*************************************************************/
import java.util.Scanner;
public class Grade {
    public static void main(String[] args) {
        Scanner in = new Scanner(System.in);

        System.out.print("Enter the student's grade: ");
        int grade = in.nextInt();

        if (grade >= 90) {
            System.out.println("A");
        } else if (grade >= 80) {
            System.out.println("B");
        } else if (grade >= 70) {
            System.out.println("C");
        } else if (grade >= 60) {
            System.out.println("D");
        } else {
            System.out.println("F");
        }
    }
}
```

```
Enter the student's grade: 84
B
```

Trace if-else statement

```java
/*************************************************************
Conditional statements
Author: Dr. Fadi Alzhouri
Example 14: Nested If-else statements
*************************************************************/
import java.util.Scanner;
public class Grade {
    public static void main(String[] args) {
        Scanner in = new Scanner(System.in);

        System.out.print("Enter the student's grade: ");
        int grade = in.nextInt();

        if (grade >= 90) {
            System.out.println("A");
        } else if (grade >= 80) {
            System.out.println("B");
        } else if (grade >= 70) {
            System.out.println("C");
        } else if (grade >= 60) {
            System.out.println("D");
        } else {
            System.out.println("F");
        }
    }
}
```

Assume your grade is 84

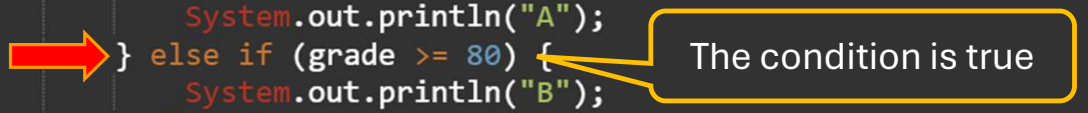
Trace if-else statement

```java
/*************************************************************
Conditional statements
Author: Dr. Fadi Alzhouri
Example 14: Nested If-else statements
*************************************************************/
import java.util.Scanner;
public class Grade {
    public static void main(String[] args) {
        Scanner in = new Scanner(System.in);

        System.out.print("Enter the student's grade: ");
        int grade = in.nextInt();

        if (grade >= 90) {
            System.out.println("A");
        } else if (grade >= 80) {
            System.out.println("B");
        } else if (grade >= 70) {
            System.out.println("C");
        } else if (grade >= 60) {
            System.out.println("D");
        } else {
            System.out.println("F");
        }
    }
}
```

The condition is false

Trace if-else statement

```java
/*************************************************************
Conditional statements
Author: Dr. Fadi Alzhouri
Example 14: Nested If-else statements
*************************************************************/
import java.util.Scanner;
public class Grade {
    public static void main(String[] args) {
        Scanner in = new Scanner(System.in);

        System.out.print("Enter the student's grade: ");
        int grade = in.nextInt();

        if (grade >= 90) {
            System.out.println("A");
        } else if (grade >= 80) {
            System.out.println("B");
        } else if (grade >= 70) {
            System.out.println("C");
        } else if (grade >= 60) {
            System.out.println("D");
        } else {
            System.out.println("F");
        }
    }
}
```



Trace if-else statement

```java
/*************************************************************
Conditional statements
Author: Dr. Fadi Alzhouri
Example 14: Nested If-else statements
*************************************************************/
import java.util.Scanner;
public class Grade {
    public static void main(String[] args) {
        Scanner in = new Scanner(System.in);

        System.out.print("Enter the student's grade: ");
        int grade = in.nextInt();

        if (grade >= 90) {
            System.out.println("A");
        } else if (grade >= 80) {
            System.out.println("B");
        } else if (grade >= 70) {
            System.out.println("C");
        } else if (grade >= 60) {
            System.out.println("D");
        } else {
            System.out.println("F");
        }
    }
}
```

The grade is B

```
Enter the student's grade: 84
B
```

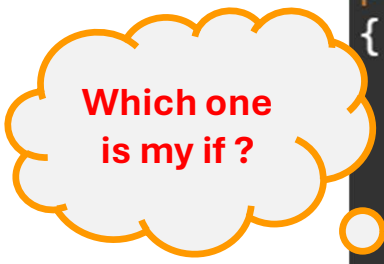
Trace if-else statement

```java
/*************************************************************
Conditional statements
Author: Dr. Fadi Alzhouri
Example 14: Nested If-else statements
*************************************************************/
import java.util.Scanner;
public class Grade {
    public static void main(String[] args) {
        Scanner in = new Scanner(System.in);

        System.out.print("Enter the student's grade: ");
        int grade = in.nextInt();

        if (grade >= 90) {
            System.out.println("A");
        } else if (grade >= 80) {
            System.out.println("B");
        } else if (grade >= 70) {
            System.out.println("C");
        } else if (grade >= 60) {
            System.out.println("D");
        } else {
            System.out.println("F");
        }
    }
}
```

Exit if statement

```
Enter the student's grade: 84
B
```

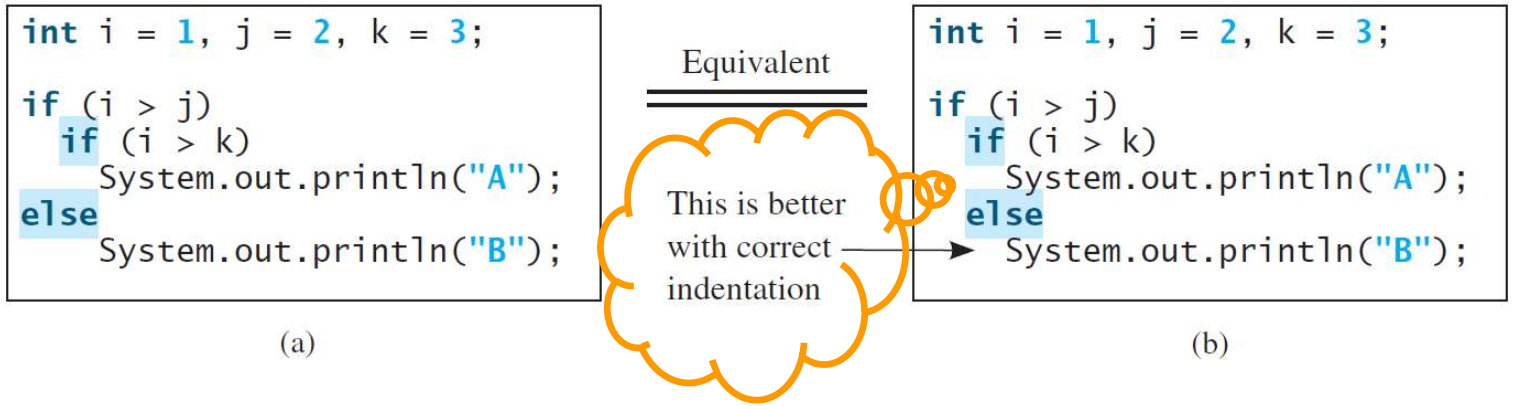
Dangling-else Problem




```java
/*************************************************************
Conditional statements
Author: Dr. Fadi Alzhouri
Example 14: dangling-else statement
*************************************************************/
public class Dangling
{
    public static void main(String[] args) {
        int x = -1, y = 2;
        if (x > 0)        // outer-if
            if (y > 0)    // inner-if
                System.out.println("x and y are positive");
        else System.out.println("x is positive");
        System.out.println("x and y are integers");
    }
}
```

The compiler resolves the dangling else problem by associating the else clause with the nearest if

Dangling-else Problem (cont.)



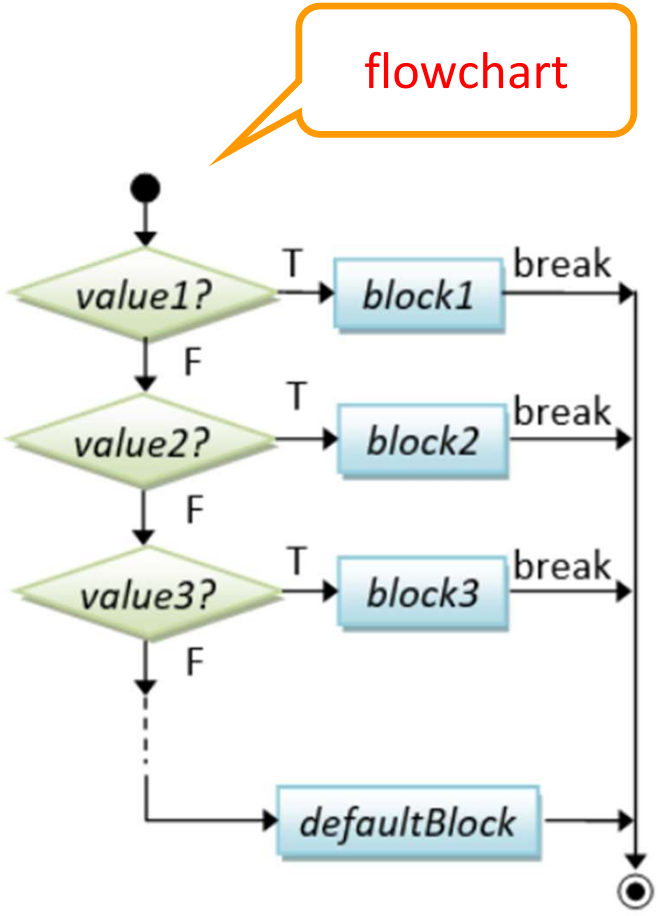
Switch Statement

- A switch statement executes statements based on the value of a variable or an expression.
- The switch statement is used for checking a variable against a list of values (cases).
- It primarily handles equality checks.
- It is an alternative to the "nested-if" for fixed-value tests (but not applicable for range tests).

Switch Statement (cont.)

- Syntax:

```
switch (expression) {
    case value1:
        block1;
        break;
    case value2:
        block2;
        break;
    ......
    case valueN:
        blockN;
        break;
    default: // not the above
        defaultBlock;
```



Switch Statement (cont.)

- Switch rules:
  - The switch-expression must yield a value of char, byte, short, int, or String type and must always be enclosed in parentheses.
  - The expression in the switch statement is evaluated at runtime to determine which case to execute.
  - The value1, . . ., and valueN must have the same data type as the value of the switch expression.
  - value1, . . ., and valueN in the case statements are constant expressions, not variables.
  - The keyword break is optional, but it should be used at the end of each case to exit the switch statement. If the break statement is not present, the next case statement will be executed.
  - The default case, optional, can be used to perform actions when none of the specified cases matches the switch expression.

Switch Statement (cont.)

```java
/*************************************************************
Conditional statements
Author: Dr. Fadi Alzhouri
Example 15: switch statement
*************************************************************/
public class Switch2
{
    public static void main(String[] args) {
        int option = 2;
        switch (option) {
            case 1:
                System.out.println("1: means yes");
                break;
            case 2:
                System.out.println("2: means no");
                break;
            default:
                System.out.println("Invalid input! Please enter 1 or 2");
        }
        System.out.println("After the switch statement");
    }

}
```

Mach case 2

Switch Statement (cont.)

```java
/*************************************************************
Conditional statements
Author: Dr. Fadi Alzhouri
Example 15: switch statement
*************************************************************/
public class Switch2
{
    public static void main(String[] args) {
        int option = 2;
        switch (option) {
            case 1:
                System.out.println("1: means yes");
                break;
            case 2:
                System.out.println("2: means no");
                break;
            default:
                System.out.println("Invalid input! Please enter 1 or 2");
        }
        System.out.println("After the switch statement");
    }

}
```

Print this msg.

```
2: means no
```

Switch Statement (cont.)

```java
/*************************************************************
Conditional statements
Author: Dr. Fadi Alzhouri
Example 15: switch statement
*************************************************************/
public class Switch2
{
    public static void main(String[] args) {
        int option = 2;
        switch (option) {
            case 1:
                System.out.println("1: means yes");
                break;
            case 2:
                System.out.println("2: means no");
                break;
            default:
                System.out.println("Invalid input! Please enter 1 or 2");
        }
        System.out.println("After the switch statement");
    }

}
```

Exit switch body

```
2: means no
```

Switch Statement (cont.)

```
/*************************************************************
Conditional statements
Author: Dr. Fadi Alzhouri
Example 15: switch statement
*************************************************************/
public class Switch2
{
    public static void main(String[] args) {
        int option = 2;
        switch (option) {
            case 1:
                System.out.println("1: means yes");
                break;
            case 2:
                System.out.println("2: means no");
                break;
            default:
                System.out.println("Invalid input! Please enter 1 or 2");
        }
        System.out.println("After the switch statement");
    }

}
```

Print this msg.

```
2: means no
After the switch statement
```

Exercise

- What is the output if the user enters 100?

```
Author: Dr. Fadi Alzhouri
Example 16: Switch statement
*************************************************************/
import java.util.Scanner;
public class Switchtest
{
    public static void main(String[] args) {
        Scanner number = new Scanner(System.in);
        int grade, category;
        System.out.println("Enter your garde (0 - 100): ");
        grade = number.nextInt();
        category = grade/10;
        switch (category) {
            case 10:
            case 9:
                System.out.println("Excellent "); break;
            case 8:
                System.out.println("Nice job"); break;
            case 7:
                System.out.println("average"); break;
            case 6:
                System.out.println("below average"); break;
            default: // not the above
                System.out.println("you are in trouble");
        }
    }
}
```

Exercise (cont.)

```
Author: Dr. Fadi Alzhouri
Example 16: Switch statement
**********************************************************/
import java.util.Scanner;
public class Switchtest
{
    public static void main(String[] args) {
        Scanner number = new Scanner(System.in);
        int grade, category;
        System.out.println("Enter your garde (0 - 100): ");
        grade = number.nextInt();
        category = grade/10;
        switch (category) {
            case 10:
            case 9:
                System.out.println("Excellent "); break;
            case 8:
                System.out.println("Nice job"); break;
            case 7:
                System.out.println("average"); break;
            case 6:
                System.out.println("below average"); break;
            default: // not the above
                System.out.println("you are in trouble");
        }
    }
}
```

10

Exercise (cont.)

```
Author: Dr. Fadi Alzhouri
Example 16: Switch statement
**********************************************************/
import java.util.Scanner;
public class Switchtest
{
    public static void main(String[] args) {
        Scanner number = new Scanner(System.in);
        int grade, category;
        System.out.println("Enter your garde (0 - 100): ");
        grade = number.nextInt();
        category = grade/10;
        switch (category) {
            case 10:
            case 9:
                System.out.println("Excellent "); break;
            case 8:
                System.out.println("Nice job"); break;
            case 7:
                System.out.println("average"); break;
            case 6:
                System.out.println("below average"); break;
            default: // not the above
                System.out.println("you are in trouble");
        }
    }
}
```

Evaluates 10

Exercise (cont.)

```
Author: Dr. Fadi Alzhouri
Example 16: Switch statement
**********************************************************/
import java.util.Scanner;
public class Switchtest
{
    public static void main(String[] args) {
        Scanner number = new Scanner(System.in);
        int grade, category;
        System.out.println("Enter your garde (0 - 100): ");
        grade = number.nextInt();
        category = grade/10;
        switch (category) {
            case 10:
            case 9:
                System.out.println("Excellent "); break;
            case 8:
                System.out.println("Nice job"); break;
            case 7:
                System.out.println("average"); break;
            case 6:
                System.out.println("below average"); break;
            default: // not the above
                System.out.println("you are in trouble");
        }
    }
}
```

Match case 10

Exercise (cont.)

```
Author: Dr. Fadi Alzhouri
Example 16: Switch statement
**********************************************************/
import java.util.Scanner;
public class Switchtest
{
    public static void main(String[] args) {
        Scanner number = new Scanner(System.in);
        int grade, category;
        System.out.println("Enter your garde (0 - 100): ");
        grade = number.nextInt();
        category = grade/10;
        switch (category) {
            case 10:
            case 9:
                System.out.println("Excellent "); break;
            case 8:
                System.out.println("Nice job"); break;
            case 7:
                System.out.println("average"); break;
            case 6:
                System.out.println("below average"); break;
            default: // not the above
                System.out.println("you are in trouble");
        }
    }
}
```

Continue to case 9

Exercise (cont.)

```
Author: Dr. Fadi Alzhouri
Example 16: Switch statement
**********************************************************/
import java.util.Scanner;
public class Switchtest
{
    public static void main(String[] args) {
        Scanner number = new Scanner(System.in);
        int grade, category;
        System.out.println("Enter your garde (0 - 100): ");
        grade = number.nextInt();
        category = grade/10;
        switch (category) {
            case 10:
            case 9:
                System.out.println("Excellent "); break;
            case 8:
                System.out.println("Nice job"); break;
            case 7:
                System.out.println("average"); break;
            case 6:
                System.out.println("below average"); break;
            default: // not the above
                System.out.println("you are in trouble");
        }
    }
}
```

Print “Excellent”

```
Excellent
```

Exercise (cont.)

```java
Author: Dr. Fadi Alzhouri
Example 16: Switch statement
**********************************************************/
import java.util.Scanner;
public class Switchtest
{
    public static void main(String[] args) {
        Scanner number = new Scanner(System.in);
        int grade, category;
        System.out.println("Enter your garde (0 - 100): ");
        grade = number.nextInt();
        category = grade/10;
        switch (category) {
            case 10:
            case 9:
                System.out.println("Excellent "); break;
            case 8:
                System.out.println("Nice job"); break;
            case 7:
                System.out.println("average"); break;
            case 6:
                System.out.println("below average"); break;
            default: // not the above
                System.out.println("you are in trouble");
        }
    }
}
```

Exit the switch body

```
Excellent
```

Exercise 2

- What is the output if the user enters 55?

```
Author: Dr. Fadi Alzhouri
Example 16: Switch statement
*************************************************************/
import java.util.Scanner;
public class Switchtest
{
    public static void main(String[] args) {
        Scanner number = new Scanner(System.in);
        int grade, category;
        System.out.println("Enter your garde (0 - 100): ");
        grade = number.nextInt();
        category = grade/10;
        switch (category) {
            case 10:
            case 9:
                System.out.println("Excellent "); break;
            case 8:
                System.out.println("Nice job"); break;
            case 7:
                System.out.println("average"); break;
            case 6:
                System.out.println("below average"); break;
            default: // not the above
                System.out.println("you are in trouble");
        }
    }
}
```

Conditional Expression (… ? … : …)

A conditional operator is a ternary (3-operand) operator, in the form of

Boolean exp. ? True block : false block

```
if(x>=0)
    y = 1;
else
    y = -1;
```

```
y = (x>=0) ? 1 : -1
```

References

- **Introduction to Java Programming, Brief Version, Global Edition, 11th edition,** Published by Pearson (June 21, 2018) © 2018