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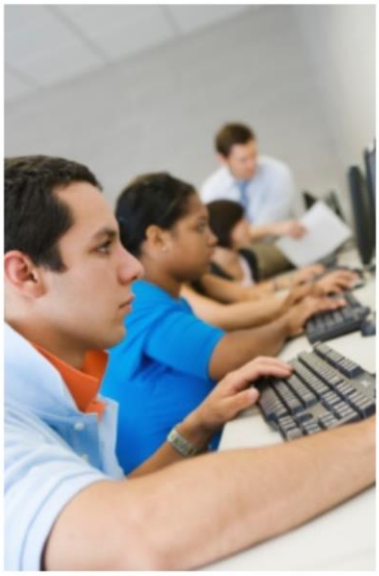
Java Foundations

5-2
Understanding Conditional Execution



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Objectives

- This lesson covers the following objectives:
  - Describe conditional execution
  - Describe logical operators
  - Understand “short circuit” evaluation of logical operators
  - Build chained if constructs

When Multiple Conditions Apply

- What if a particular action is to be taken only if several conditions are true?
- Consider the scenario where a student is eligible for scholarship if the following two conditions are met:
  - Grade should be >= 88
  - Number of days absent = 0

Handling Multiple Conditions

- Relational operators are fine when you're checking only one condition
- You can use a sequence of if statements to test more than one condition

```
if (grade >= 88) {
   if (numberDaysAbsent == 0) {
       System.out.println("You qualify for the scholarship.");
   }//endif
}//endif
```

Handling Multiple Conditions: Example

- As demonstrated in the example:
  - The sequence of if statements is hard to write, harder to read, and becomes even more difficult as you add more conditions
  - Fortunately, Java has an easy way to handle multiple conditions: logical operators

Java's Logical Operators

- You can use Java's three logical operators to combine multiple boolean expressions into one boolean expression

Logic Operator	Meaning
&&	AND
||	OR
!	NOT

Three Logical Operators

Operation	Operator	Example

If one condition AND another condition	&&	int i = 2;
		int j = 8;
		((i < 1) && (j > 6))

If either one condition OR both conditions	||	int i = 2;
		int j = 8;
		((i < 1) || (j > 10))

NOT	!	int i = 2; (!(i < 3))

The table in the slide lists the logical operators in the Java programming language. All examples yield a boolean result of false.

Applying Logical Operators

- You can write the previous example by using the logical AND operator as:

```
grade >= 88 && numberDaysAbsent == 0
```

Boolean Expression 1 | Logical Operator | Boolean Expression 2

- The logical operator allows you to test multiple conditions more easily, and the code is more readable

In this example, you use the logical AND operator because both boolean expressions must be true to make the student eligible for a scholarship.

Logical AND operator:

- Combined condition is true if and only if both boolean expressions are true.
- Combined condition is false if either or both of the boolean expressions are false.

Logical AND Operator: Example

```
public static void main(String[] args) {
   int numberDaysAbsent = 0;
   int grade = 95;
   if (grade >= 88 && numberDaysAbsent == 0) {
       System.out.println("You qualify for the scholarship.");
   }
   else {
       System.out.println("You do not qualify for the "
                          + "scholarship.");
   }//endif
}//end method main
```

Evaluates to true if both boolean expressions are true

This example illustrates the logical AND operator. For the output to be displayed as "You qualify for the scholarship," the two conditions must be true. That is, the grade must be greater than or equal to 88, and the number of days absent must be equal to zero.

Logical OR Operators

- Consider a scenario where a student is eligible for a sports team if one of the following two conditions are met:
  - Grade >= 70
  - Number of days absent < 5
- In this case, you can use the logical OR operator to connect the multiple boolean expressions

```
grade >=70  ||  numberDaysAbsent < 5
```

Boolean Expression 1 **Logical Operator** **Boolean Expression 2**

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Combined condition is true if either or both of the boolean expressions are true.
Combined condition is false if both of the boolean expressions are false.

Logical OR Operators: Example

```
public static void main(String[] args) {
   int numberDaysAbsent = 3;
   int grade = 85;
   if (grade >= 70 || numberDaysAbsent < 5) {
       System.out.println("You qualify for a sports team");
   }
   else {
       System.out.println("You do not qualify for a sports"
                          + " team");
   }//endif
}//end method main
```

Evaluates to true if either of the boolean expressions evaluates to true

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Understanding Conditional Execution

This example illustrates using the logical OR operator. In this example, "You qualify for a sports team" is displayed even if one of the conditions is true. That is, the grade must be >= 70 or the number of days absent must be less than five.

Logical NOT Operators

- Consider a scenario where a student is eligible for free tutoring if the following two conditions are met:
  - Grade < 88
  - Number of days absent < 3
- Use the ! logical operator

```
!madeFreeTutor && numberDaysAbsent < 3
```

Logical Operator — **Boolean Expression 1** — **Boolean Expression 2**

This example illustrates the logical ! operator. Because the grade is equal to 65, !madeFreeTutor is true because madeFreeTutor is false.
The combined expression evaluates to true and the following output is displayed: "You qualify for free tutoring help."

Logical NOT Operators

```
public static void main(String args[]) {
    int numberDaysAbsent = 2;
    int grade = 65;
    boolean madeFreeTutor = grade >= 88;
    if (!madeFreeTutor && numberDaysAbsent < 3) {
       System.out.println("You qualify for free tutoring "
                          + " help");
    }//endif
 }//end method main
```


This example illustrates the logical ! operator. Because the grade is equal to 65, !madeFreeTutor is true because madeFreeTutor is false.
The combined expression evaluates to true and the following output is displayed: "You qualify for free tutoring help."

Exercise 1

- Import and open the `ConditionalEx` project
- Modify `WatchMovie.java` to watch a movie that meets the following two conditions:
- The movie price is greater than or equal to $12
- The movie rating is equal to 5
  - Display the output as "**I'm interested in watching the movie**"
  - Else display the output as "**I am not interested in watching the movie**"

Skipping the Second AND Test

- The && and || operators are short-circuit operators
- If the 1st expression (on the left) is false, there is no need to evaluate the 2nd expression (on the right)

```
b = (x != 0) && ((y / x) > 2);
```

Left Expression

Right Expression

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The evaluation is performed in left-to-right order and halts as soon as the result is known. This means that the expression on the right side won't be evaluated if it isn't necessary.

Skipping the Second AND Test

```
b = (x != 0) && ((y / x) > 2);
```

Left Expression

Right Expression

- If x is 0 then (x != 0)is false
- For the && operator, because it doesn't matter whether ((y/x)>2)is true or false, the result of this expression is false
- So Java doesn't continue evaluating ((y/x)>2)

Skipping the Second OR Test

- If the 1st expression (on the left) is true, there is no need to evaluate the 2nd expression (on the right)
- Consider this example:

```
boolean b = (x <= 10) || (x > 20);
```

Left Expression **Right Expression**

- If (x<=10) is true, then (x>20) is not evaluated because it doesn't matter if (x>20) is true or false
- The result of this expression is true

What Is a Ternary Conditional Operator?

Operation	Operator	Example

If condition is true, assign result = value1
Otherwise, assign result = value2
Note: value1 and value2 must be the same data type
	?:	result=condition ? value1 : value2
		
		Example:
		int x = 2, y = 5, z = 0;
		
		z = (y < x) ? x : y;

Equivalent statements

```
z = (y < x) ? x : y;
```

```
if(y<x){
  z=x;
}
else{
  z=y;
}//endif
```


The ternary operator is a conditional operator that requires three operands. It has a more compact syntax than an if/else statement.
Use the ternary operator instead of an if/else statement if you want to make your code shorter.
There are three operands in the slide example:

(y < x): This boolean expression (condition) is being evaluated.
? x : If (y < x) is true, z will be assigned the value of x.
: y : If (y < x) is false, z will be assigned the value of y.

In the slide example, z = 5.

Ternary Conditional Operator: Scenario

- Assume that you're playing a soccer game and you're tracking the goals as follows:

```
public static void main(String args[]) {
   int numberOfGoals = 5;
   String s;
   if (numberOfGoals == 1) {
      s = "goal";
   }
   else {
      s = "goals";
   }//endif
   System.out.println("I scored " + numberOfGoals + " " + s);
}//end method main
```


Based on the number of goals scored, these examples will print the appropriate singular or plural form of "goal." The operation is compact because it can yield only two results based on a boolean expression.

Ternary Conditional Operator: Example

- A similar result is achieved with the ternary operator by replacing the entire if/else statement with a single line

```
int numberOfGoals = 1;

System.out.println("I scored " + numberOfGoals + " "
                   + (numberOfGoals == 1 ? "goal" : "goals")
);
```

Ternary Conditional Operator: Example

- Advantage: Place the operation directly within an expression

```
int numberOfGoals = 1;

System.out.println("I scored " + numberOfGoals + " "
                   + (numberOfGoals == 1 ? "goal" : "goals")
);
```

- Disadvantage: Can have only two potential results

```
(numberOfGoals==1 ? "goal" : "goals" : "More goals");
```

boolean — true — false — ???

As you can see, the ternary operator can be useful to reduce the number of lines of code, but it can make your code difficult to read and so it isn't ideal for nested statements.

Exercise 2

- Import and open the `ConditionalEx` project
- Modify `TernaryOperator.java` to duplicate the logic given in the if/else statement by using the ternary operator

Handling Complex Conditions with a Chained if Construct

- The chained if statement:
  - Connects multiple conditions together into a single construct
  - Tends to be confusing to read and hard to maintain

Chaining if/else Constructs

- You can chain if and else constructs together to state multiple outcomes for several different expressions
- Syntax:

```
if (<condition1>) {
   //code_block1
}
else if (<condition2>) {
   // code_block2
}
else {
   // default_code
}//endif
```


The syntax for a chained if/else construct is shown in the slide example:

Each of the conditions is a boolean expression.
code_block1 represents the lines of code that are executed if condition1 is true.
code_block2 represents the lines of code that are executed if condition1 is false and condition2 is true.
default_code represents the lines of code that are executed if both conditions evaluate to false.

Note: Multiple else if statements can be evaluated. The else statement is optional.

Chaining if/else Constructs: Example

```
public static void main(String args[]) {
   double income = 30000, tax;

   if (income <= 15000) {
      tax = 0;
   }
   else if (income <= 25000) {
      tax = 0.05 * (income - 15000);
   }
   else {
      tax = 0.05 * (income - (25000 - 15000));
      tax += 0.10 * (income - 25000);
   }//endif
}//end method main
```


This example demonstrates chaining if/else constructs to test multiple conditions. The else statement is executed if all conditions are false.

Can if Statements Be Nested?

- In Java, an if statement can be present inside the body of another if statement

```
if (tvType == "color") {
   if (size == 14) {
       discPercent = 8;
   }
   else {
       discPercent = 10;
   }//endif
}//endif
```

- In this example, the else statement is paired with the if statement (size==14)

In a nested if statement:
It's very important to be sure which else construct goes with which if construct. This indentation greatly aids the clarity of the code for a reader.
In this example, if the outer if statement is true, then the inner if statement is executed.

Understanding Nested if Statements

- In this example, the else statement is paired with the outer if statement (`TVType=="color"`)

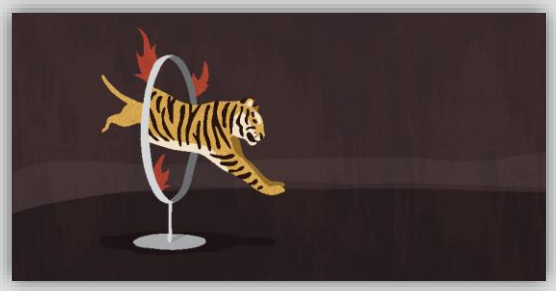
```
 if (tvType == "color") {
    if (size == 14) {
        discPercent = 8;
     }//endif
 }
 else {
    discPercent = 10;
}//endif
```

Exercise 3

- Import and open the `ConditionalEx` project
- Examine `ComputeFare.java`
- Implement the following using if/else constructs:
  - Declare an integer variable, age
  - Have the user enter the value for age
- Using a chained if construct, compute the fare based on the age according to these conditions:
  - If age is less than 11, then fare=3$
  - If age is greater than 11 and less than 65, then fare=5$
  - Else for all other ages, then fare=3$

Summary

- In this lesson, you should have learned how to:
  - Describe conditional execution
  - Describe logical operators
  - Understand “short circuit” evaluation of logical operators
  - Build chained if constructs

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