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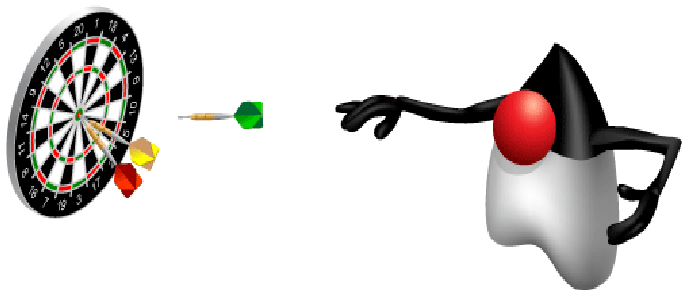
Java Foundations

5-2
Understanding Conditional Execution

Objectives

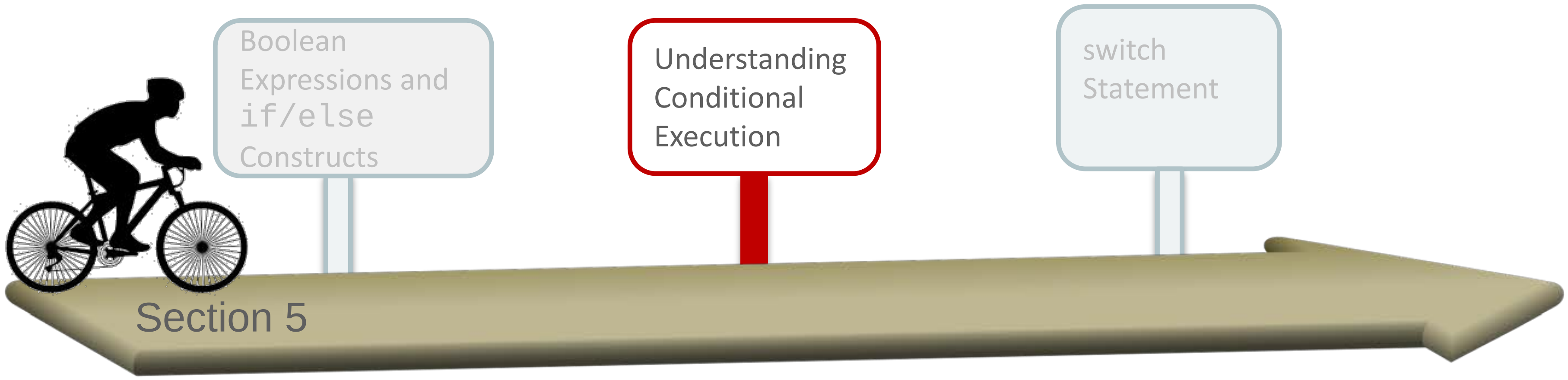
This lesson covers the following objectives:

- Describe conditional execution
- Describe logical operators
- Understand "short circuit" evaluation of logical operators
- Build chained `if` constructs



Topics

- Logical Operators
- Short-Circuit Evaluation
- Ternary Operator
- Build Chained `if` Constructs


Boolean Expressions and if/else Constructs
Understanding Conditional Execution
switch Statement
Section 5

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.");
    }
}
```

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))`

Applying Logical Operators

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

$$\underbrace{\texttt{grade >= 88}}_{\text{Boolean Expression 1}}\ \underbrace{\boxed{\texttt{\&\&}}}_{\text{Logical Operator}}\ \underbrace{\texttt{numberDaysAbsent == 0}}_{\text{Boolean Expression 2}}$$

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

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.");
   }
}
```

Evaluates to true if both boolean expressions are true.

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.

$$\underbrace{\texttt{grade >=70}}_{\text{Boolean Expression 1}}\quad\underbrace{\texttt{||}}_{\text{Logical Operator}}\quad\underbrace{\texttt{numberDaysAbsent < 5}}_{\text{Boolean Expression 2}}$$

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");
   }
}
```

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

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.

$$\underbrace{\texttt{!}}_{\text{Logical Operator}}\underbrace{\texttt{madeFreeTutor}}_{\text{Boolean Expression 1}}\ \texttt{\&\&}\ \underbrace{\texttt{numberDaysAbsent < 3}}_{\text{Boolean Expression 2}}$$

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");
    }
}
```

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.”

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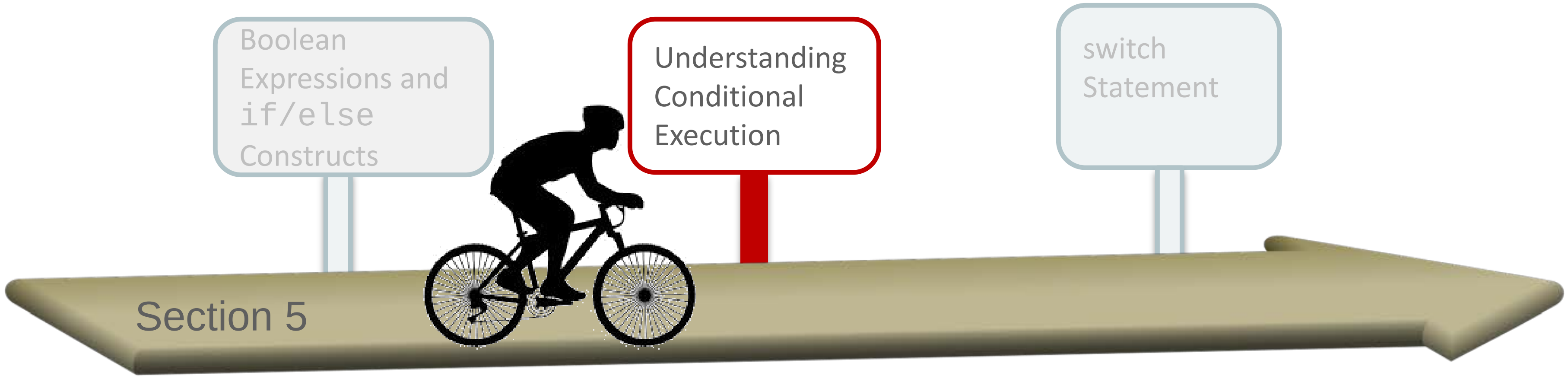

Boolean Expressions and if/else Constructs
Understanding Conditional Execution
switch Statement
Section 5

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).

$$\texttt{b = }\underbrace{\texttt{(x != 0)}}_{\text{Left Expression}}\ \texttt{\&\&}\ \underbrace{\texttt{((y / x) > 2)}}_{\text{Right Expression}}\texttt{;}$$

Skipping the Second AND Test

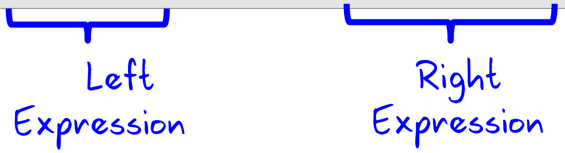
$$\texttt{b = }\underbrace{\texttt{(x != 0)}}_{\text{Left Expression}}\texttt{ \&\& }\underbrace{\texttt{((y / x) > 2)}}_{\text{Right Expression}}\texttt{;}$$

- 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);
```



- 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`.

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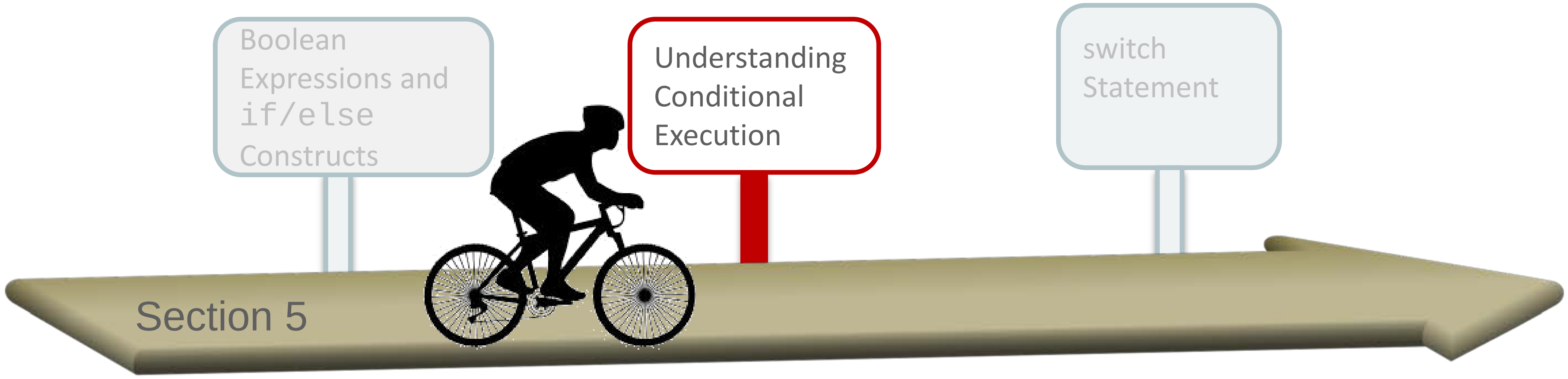
Boolean Expressions and if/else Constructs
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switch Statement
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What Is a Ternary Conditional Operator?

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;
}
```

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";
        }
       System.out.println("I scored " + numberOfGoals + " " + s);
}
```

Ternary Conditional Operator: Example

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

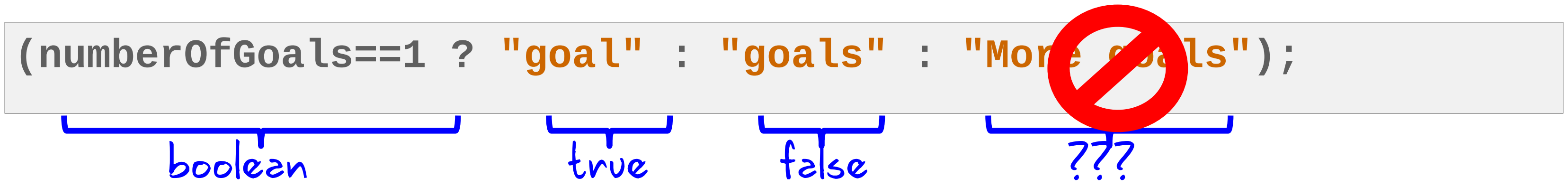
```
int numberOfGoals = 1
System.out.println("I scored " +numberOfGoals +" "
+(numberOfGoals==1 ? "goal" : "goals") );
```

Ternary Conditional Operator: Example

- Advantage: Place the operation directly within an expression.

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

- Disadvantage: Can have only two potential results.



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

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.

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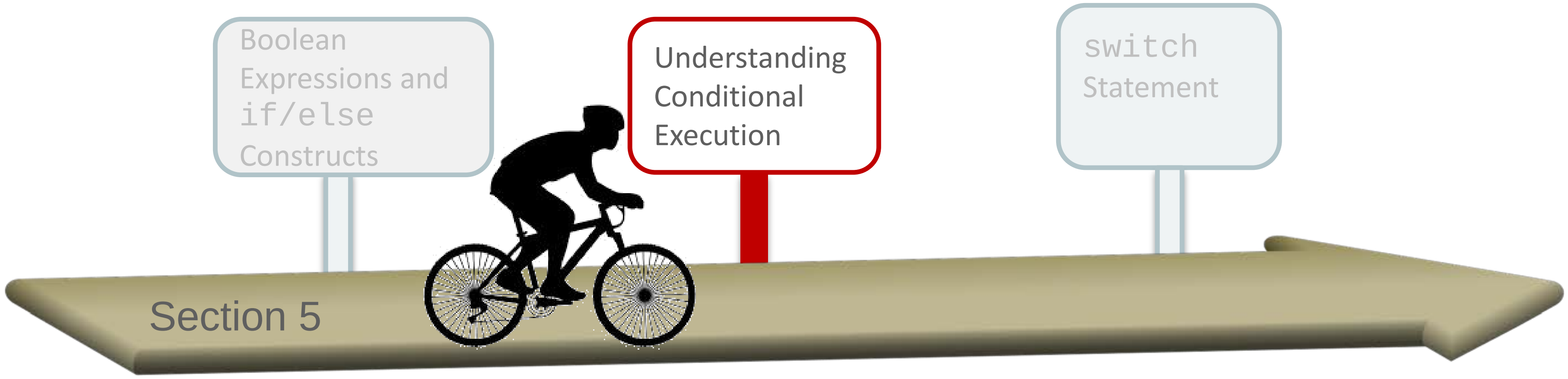

Boolean Expressions and if/else Constructs
Understanding Conditional Execution
switch Statement
Section 5

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
}
```

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);
       }
}
```

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 {
       disPercent = 10;
   }
}
```

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

Understanding Nested `if` Statements

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

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

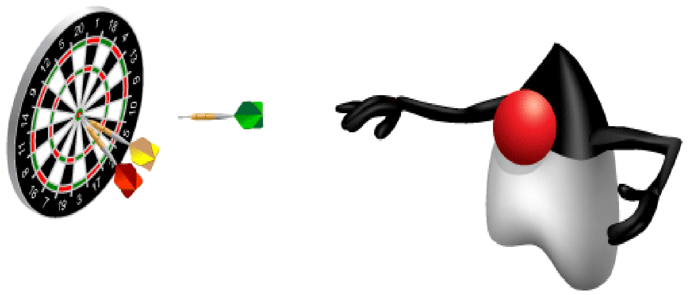
Exercise 3

- 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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