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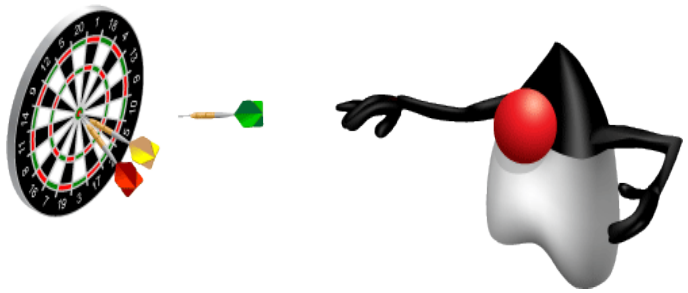
Java Foundations

5-1
`boolean` Expressions and if/else `Constructs`

Objectives

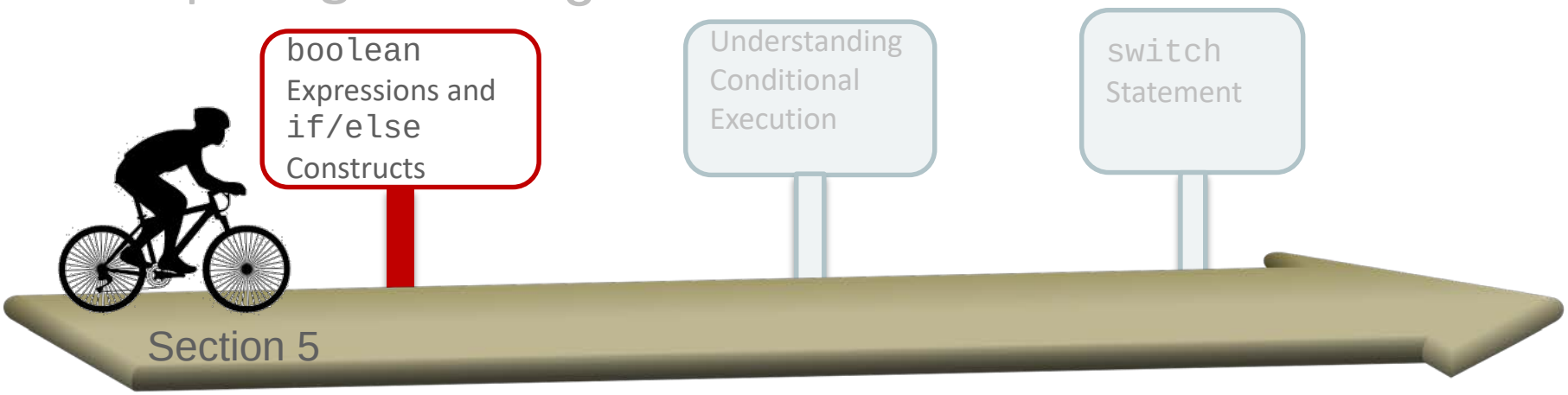
This lesson covers the following objectives:

- Declare, initialize, and use `boolean` variables
- Compare `boolean` expressions using relational operators
- Create an `if` statement
- Create `if/else` constructs
- Compare `Strings`



Topics

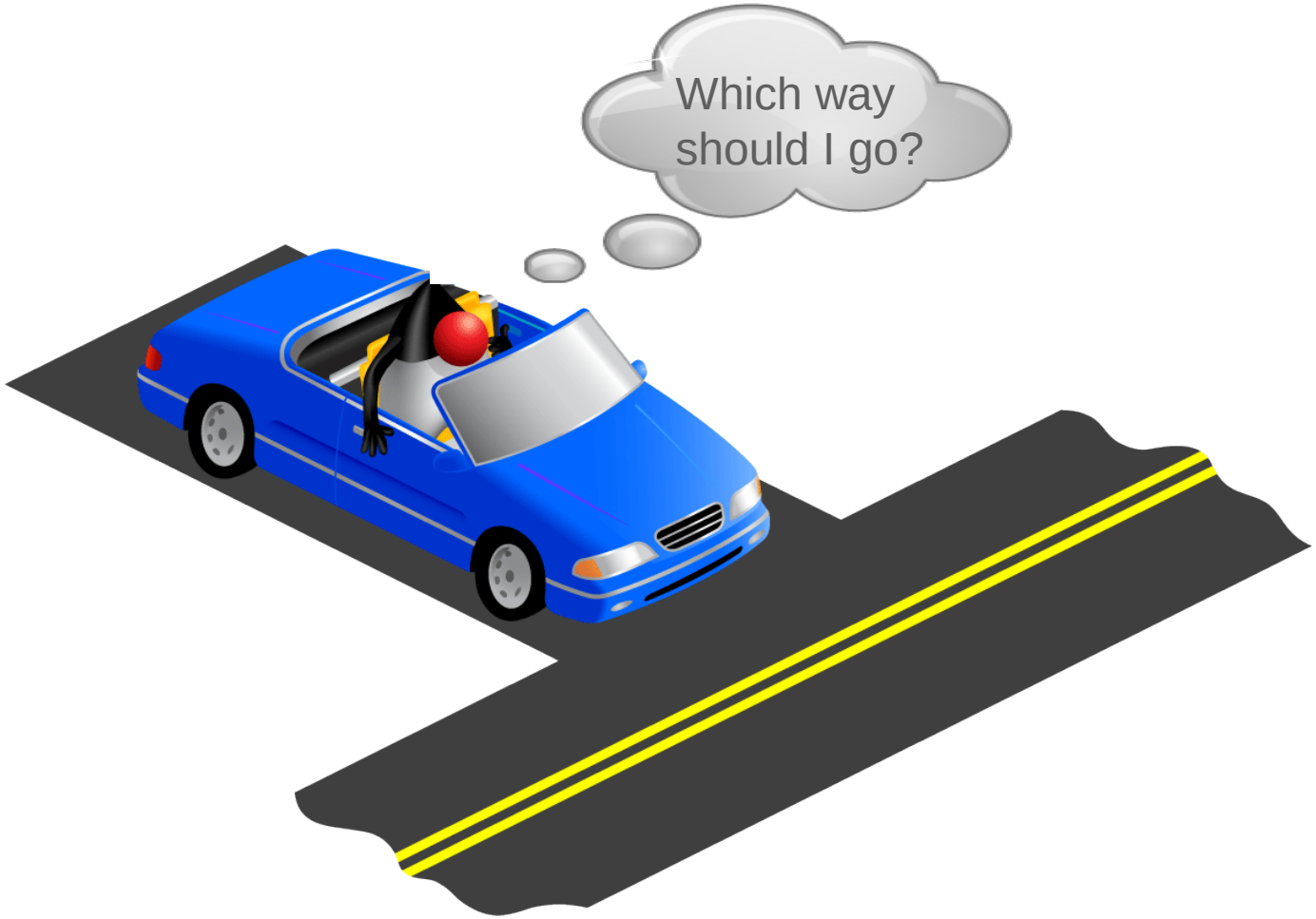
- Making Decisions
- Relational Operators
- `if` Statement
- `if/else` Constructs
- Comparing `String` Variables



Making Decisions

- So far in the previous lessons, you saw different data types supported in Java.
- `boolean` is another data type in Java that helps to add logic to a program.
- It helps to make decisions.

Making Decisions



Making Decisions

- Let's say that you're driving to the school. You stop at an intersection.
- And now you have to make a logical decision:
  - If I turn left, will it take me to the school?
  - If I go straight, will it take me to the school?
  - If I turn right, will it take me to the school?
- There are only two answers to each of these questions: yes or no.

Java's `boolean` Data Type

- It's basically the same in Java, where `booleans` will tell the program which is the best course of action to take.
- In Java the values for the `boolean` data type are `true` and `false`, instead of yes and no.
- You declare the `boolean` data type by using the `boolean` keyword.

Using Java's `boolean` Data Type: Example

```
public static void main(String args[]) {
    boolean passed, largeVenue, grade;
    passed = true;
    largeVenue = false;
    grade = passed;
    System.out.println(passed);
    System.out.println(largeVenue);
    System.out.println(grade);
 }
```

Declaring boolean variables

Assigning values to boolean variables

Printing values of boolean variables

Note: The value of a `boolean` variable is displayed as `true` or `false`.

`boolean` Data Type: Scenario

- What if you were driving a car that has an installed GPS system running on Java?
- Before you leave home, you ask the GPS system to take you to the school.
- What simple code would you write to help you decide which way to turn?

boolean Data Type: Scenario

Let's start.

```
public static void main(String args[]) {
    String left = "museum";
    String straight = "gym";
    String right = "restaurant";
    boolean isLeft = false;
    boolean isStraight = true;
    boolean isRight = false;
    System.out.println("Go straight ahead");
}
```

Expressions and Variables

Mathematical expressions can be …

- Printed
- Assigned to an `int` or `double` variable

```
System.out.println(2 + 2);
int x = 2 + 2;
```

Expressions and Variables

`boolean` expressions can be …

- Printed
- Assigned to a `boolean` variable

```
System.out.println(x == 5);
boolean isFive = x == 5;
```

Equality and Assignment

- == is a relational operator.
- This operator tests to see if both sides of a `boolean` expression equal each other.
- A `boolean` expression returns a value of `true` or `false`.

```
x == 5
```

Equality and Assignment

- = is an assignment operator.
- This operator assigns a value to a variable.
- A `boolean` variable can be assigned whichever value a `boolean` expression returns.

```
int x = 4;
boolean isFive = x == 5;
```

Values in boolean Expressions

- Use == to test equality between primitive values.
- boolean expressions may contain variables or hard-coded values.

```
boolean res1 = 24 == 15;
System.out.println("res1: " + res1);
int value1 = 15;
int value2 = 24;
boolean res2 = value1 == value2;
System.out.println("res2: " + res2);
```

Values in `boolean` Expressions

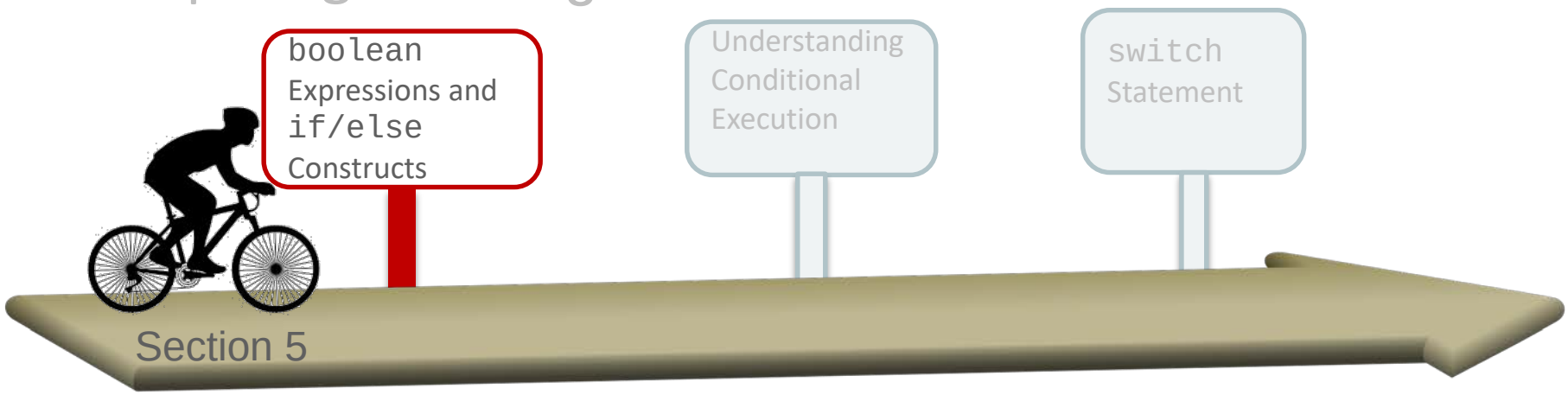
Both expressions below return the same value:

- If `value1` and `value2` hold the same value, the expression returns a `true` result.
- Otherwise, the expression returns `false`.

```
boolean res1 = 24 == 15;
System.out.println("res1: " + res1);
int value1 = 15;
int value2 = 24;
boolean res2 = value1 == value2;
System.out.println("res2: " + res2);
```

Topics

- Making Decisions
- Relational Operators
- `if` Statement
- `if/else` Constructs
- Comparing `String` Variables



Relational Operators

Use relational operators in `boolean` expressions that are used to evaluate `if/else` statements.

Relational Operators

Condition	Operator	Example
Is equal to	==	`int i=1;` `(i == 1)`
Is not equal to	!=	`int i=2;` `(i != 1)`
Is less than	<	`int i=0;` `(i < 1)`
Is less than or equal to	<=	`int i=1;` `(i <= 1)`
Is greater than	>	`int i=2;` `(i > 1)`
Is greater than or equal to	>=	`int i=1;` `(i >= 1)`

Relational Operators: Example

```
public static void main(String args[]) {
    int a = 10;
    int b = 20;
    System.out.println(a == b);
    System.out.println(a != b);
    System.out.println(a > b);
    System.out.println(a < b);
    System.out.println(b >= a);
    System.out.println(b <= a);
}
```

For primitive values == checks for equality testing

Note: Use the equal sign (=) to make an assignment and use the == sign to make a comparison and return a boolean.

Exercise 1

- Import and open the `IfElseEx` project.
- Modify `AgeValidity.java` to implement the following:
  - Have users enter their age.
  - Declare a `boolean` variable, `drivingUnderAge`.
  - Initialize `drivingUnderAge` to false.
  - Write a `boolean` expression to check if the age entered by the user is less than or equal to 18, and then set `drivingUnderAge` to `true`.
  - Print the value of `drivingUnderAge`.

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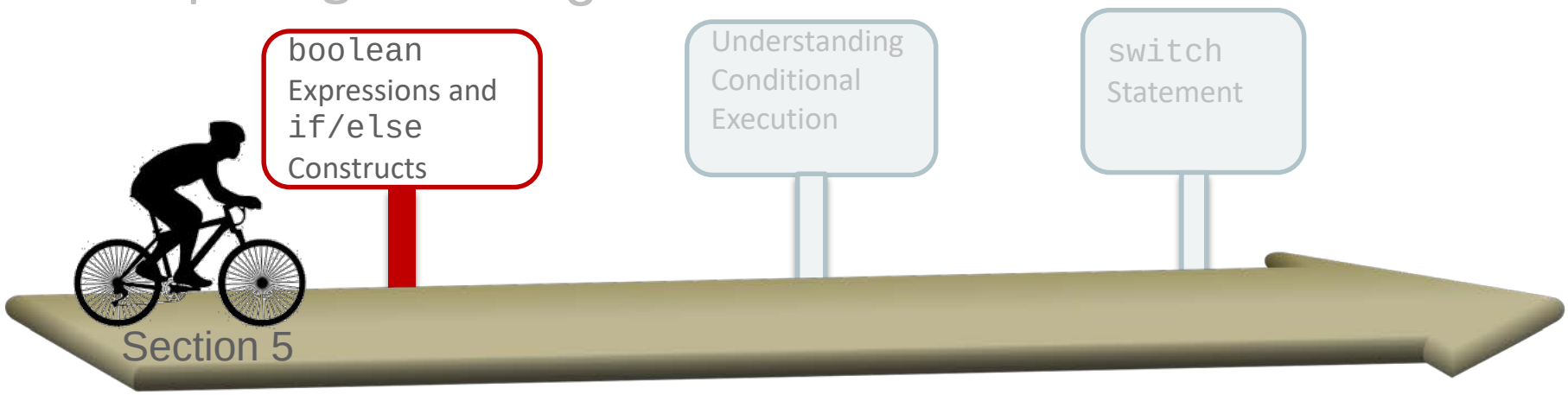


Conditional Statements

- Conditional statements let us choose which statement are executed next.
- These decisions are based on `boolean` expressions (or conditions) that evaluate to `true` or `false`.
- Conditional statements in Java are:
  - `if` statement
  - `if/else` statement
  - `switch` statement

Understanding the `if` Statement

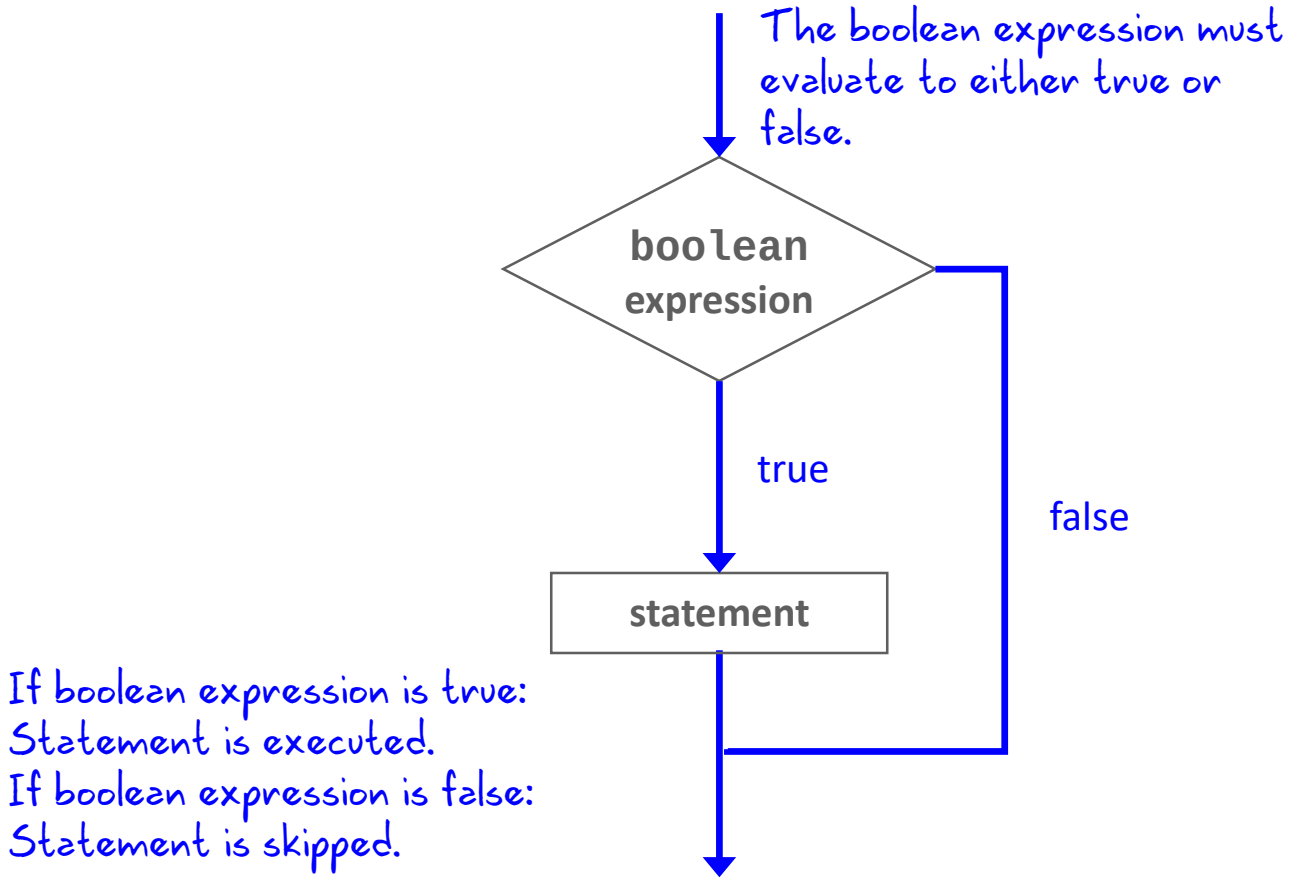
- An `if` statement consists of a `boolean` expression followed by one or more statements.
- Syntax:

boolean expression

```
if ( <some condition is true> ){

//Statements will execute if the boolean
//expression is true
}
```

Understanding the `if` Statement



Using boolean Expressions in if Statements

```
public static void main(String args[]) {
    String left = "museum";
    String straight = "gym";
    String right = "restaurant";
    if (left == "gym") {
        System.out.println("Turn Left");
    }

    if (straight== "gym") {
        System.out.println("Drive Straight");
     }

    if (right == "gym") {
        System.out.println("Turn Right");
    }
}
```

This block is executed.

Executing a Block of Code

- A code block isn't needed for one statement to be executed by an `if` statement.
- Here's an example:

```
daysInFeb = 28;
if(isLeapYear)
   daysInFeb = 29;
    System.out.println(year + "is a leap year");
```

Only this statement is executed.

1

Executing a Block of Code

```
daysInFeb = 28;
if(isLeapYear){
   daysInFeb = 29;
   System.out.println(year + "is a leap year");
}
```

2

This block is executed.

However, it's always recommended that you use code blocks, even if there's only one statement to execute in the block.

`if` Statement: Examples

```
public static void main(String args[]) {
   int grade = 85;
    if (grade > 88) {
        System.out.println("You made the Honor Roll.");

    }
    if (grade <=88) {
        System.out.println("You are eligible for tutoring.");

    }

}
```

Second if statement

Output:

```
You are eligible for tutoring.
```

Exercise 2

- Import and open the `IfElseEx` project.
- Modify the `ChkOddEven.java` to implement the following:
  - Input a number between 1 and 10.
  - Use `if` statements.
  - Test whether a number is odd or even.
- The program should generate the following output:
  - Enter a number: 7
  - The num is odd 7

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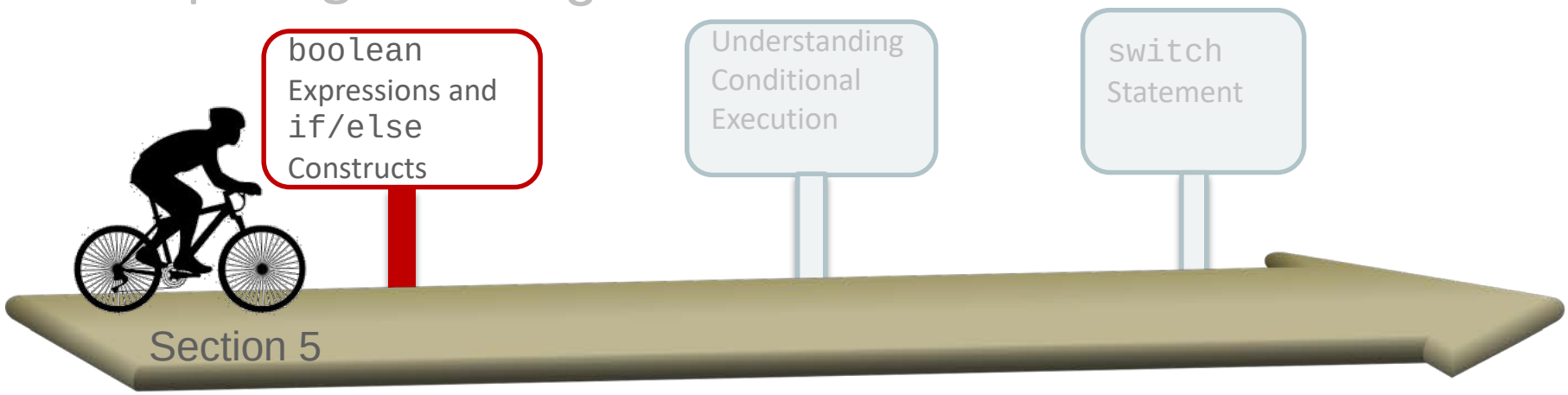
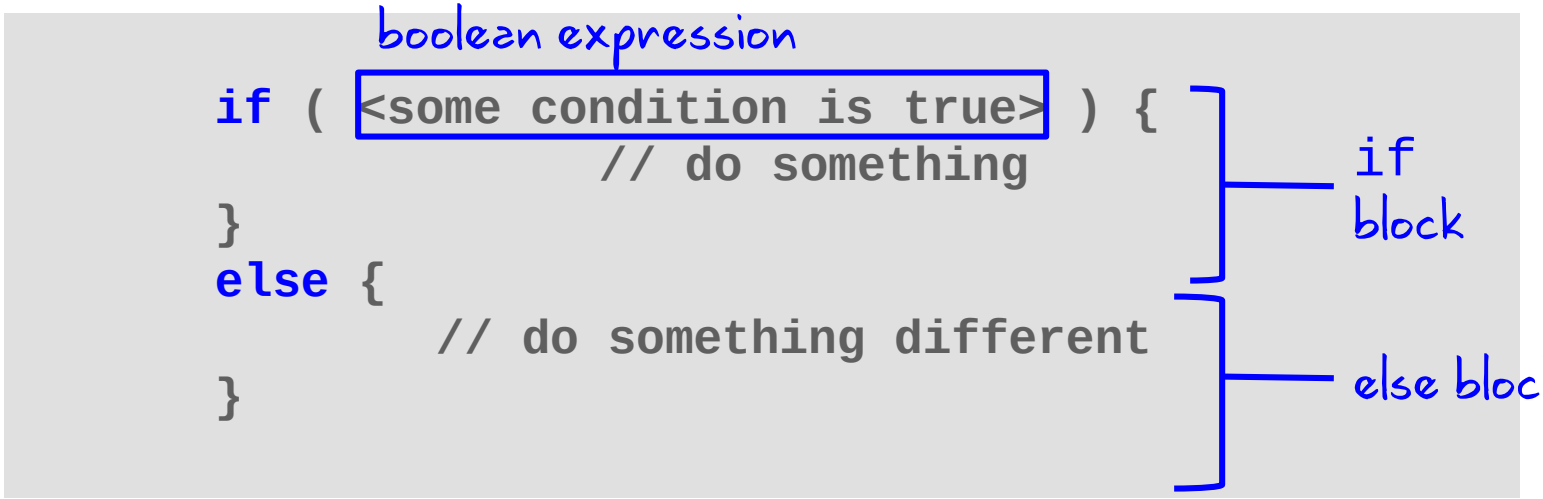
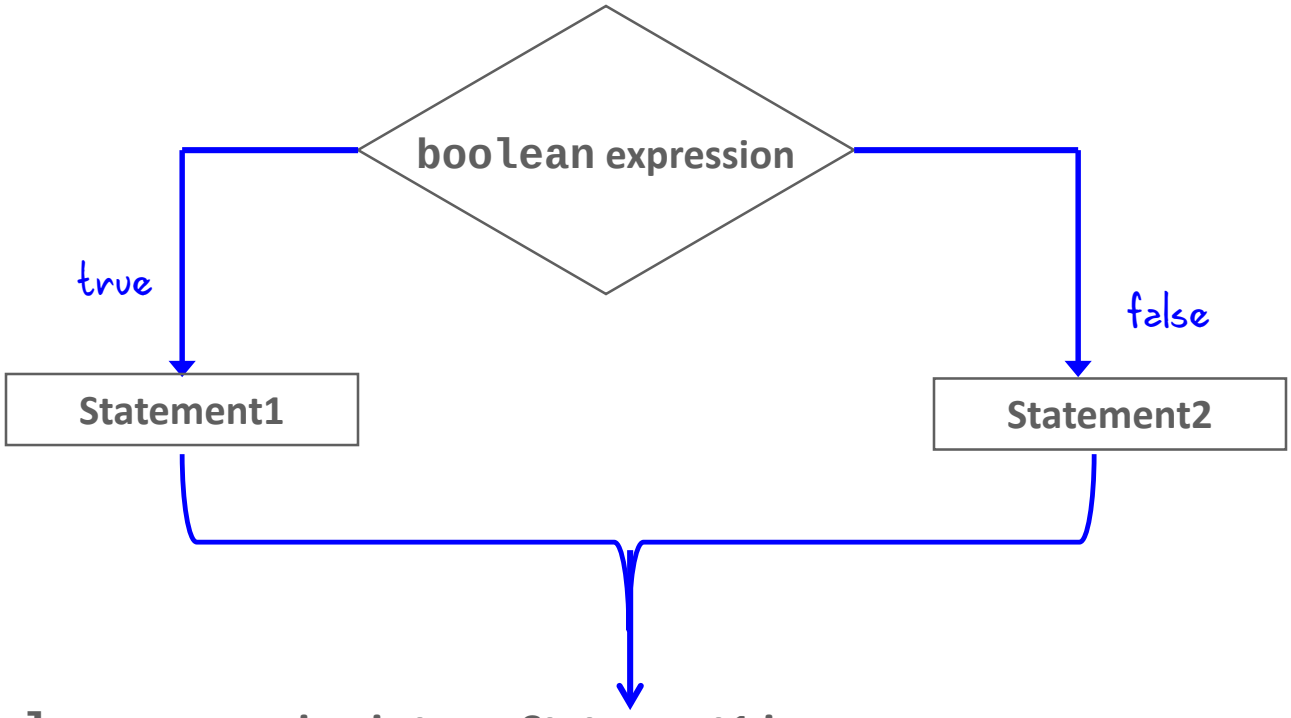


Choosing Between Two Alternatives

- If you want to choose between two alternatives you use the `if/else` statement.
- Syntax:



Understanding `if/else` Statements



If `boolean` expression is true: Statement1 is executed.
If `boolean` expression is false: Statement2 is skipped.

`if/else` Statements: Example 1

```
String forecast;
double temperature = getTemperature();

if (temperature <= 32.0) {
   forecast = "SNOW";
}
else {
   forecast = "RAIN";
}
```

This block is executed.

30.3 °F

`if/else` Statements: Example 2

40.2 °F

```
String forecast;
double temperature = getTemperature();

if (temperature <= 32.0) {
   forecast = "SNOW";
}
else {
   forecast = "RAIN";
}
```

This block is executed.

if/else Statements: Example 3

```
public static void main(String args[]) {
    int grade = 85;
    if (grade > 88) {
        System.out.println("You made the Honor Roll.");
    }
    else {
        System.out.println("You passed.");
    }
}
```

- You can replace the two `if` statements with an `if/else` statement.
- The `if/else` statement is more efficient because only one comparison is being made.

Exercise 3

- Import and open the `IfElseEx` project.
- Examine `AgeCheck.java`:
  - The program has a logic problem.
  - For some values, it prints the wrong answer.
  - Find the problems and fix them. (You may need to run the program a few times and try different values to see which ones fail.)
  - Replace the two `if` statements with an `if/else` statement.

Exercise 4

- Import and open the `IfElseEx` project.
- Examine `ShoppingCart.java`.
- Use an `if/else` statement to implement the following:
  - Declare and initialize a `boolean` variable, `outOfStock`.
  - If quantity > 1, change the message variable to indicate plural.
  - If an item is out of stock, inform the user that the item is unavailable. Else print the message and the total cost.

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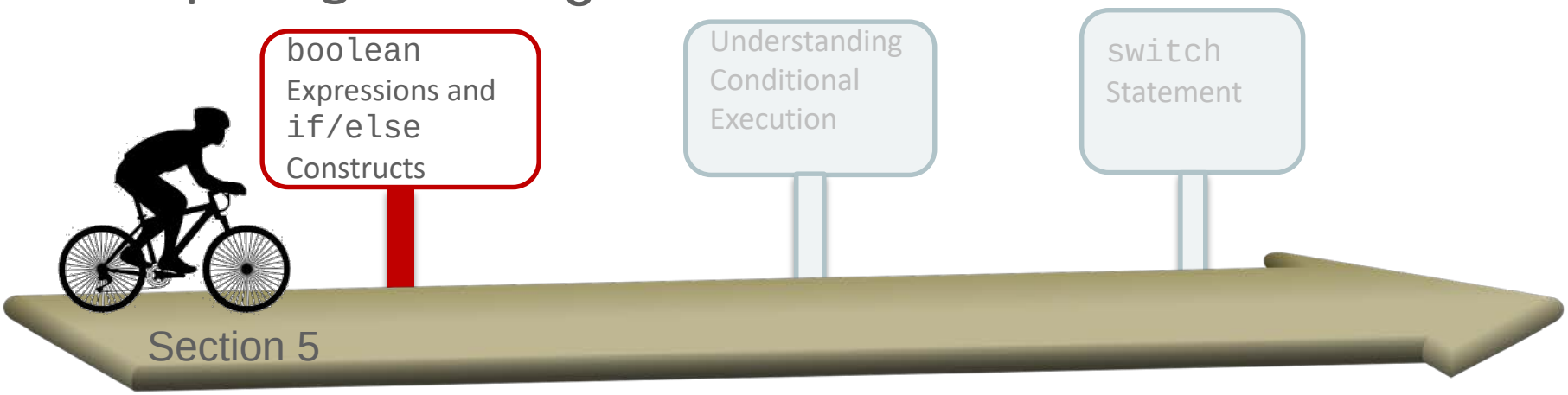


Comparing Variables

- When you compare values by using `boolean` expressions, you need to understand the nuances of certain data types.
- Relational operators such as == are …
  - Great for comparing primitives
  - Terrible for comparing `Strings` (and other objects)
- Let's examine why.

Comparing Primitives

- The value z is set to be the sum of x + y.
- When a `boolean` expression tests the equality between z and the sum of x + y, the result is `true`.

```
int x = 3;
int y = 2;
int z = x + y;

boolean test = (z == x + y);
System.out.println(test);            //true
```

Comparing `Strings`

- The value z is set to be the concatenation of x + y.
- When a `boolean` expression tests the equality between z and the concatenation of x + y, the result is `false`.

```
String x = "Ora";
String y = "cle";
String z = x + y;

boolean test = (z == x + y);
System.out.println(test);              //false
```

Why Are There Contradictory Results?

- Primitives and objects are stored differently in memory.
  - `String`s are given special treatment.
  - This is discussed later in the course.
- As a result …
  - == compares the values of primitives.
  - == compares the objects' locations in memory.
- It's much more likely that you'll need to compare the content of `String`s and not their locations in memory.

How Should You Compare `Strings`?

- You should almost never compare `Strings` using `==`.
- Instead, compare `Strings` using the `equals()` method.
  - This method is part of the `String` class.
  - It accepts one `String` argument, checks whether the contents of `Strings` are equal, and then returns a `boolean`.
  - There is also a similar method, `equalsIgnoreCase()`.

```
String x = "Ora";
String y = "cle";
String z = x + y;

boolean test = z.equals(x + y);
System.out.println(test);              //true
```

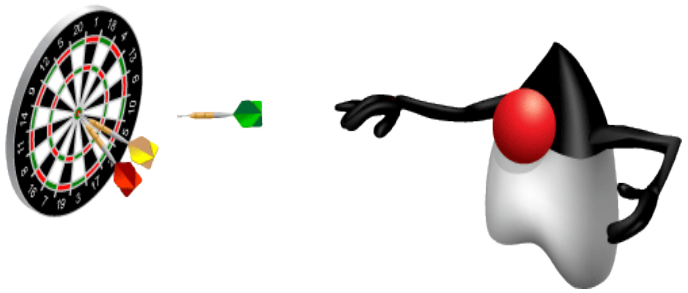
Exercise 5

- Import and open the `IfElseEx` project.
- Examine `StringEquality.java`.
- Use an `if` and an `if/else` statement:
  - Declare a `String` variable name.
  - Have the user input a value for the name.
  - Check whether the name is “Moe,” and then print “You are the king of rock and roll.”
  - Otherwise print “You are not the king.”
  - Don’t use ==.

Summary

In this lesson, you should have learned how to:

- Declare, initialize, and use `boolean` variables
- Compare primitive values using relational operators
- Create an `if` statement
- Create `if/else` constructs
- Compare `Strings`

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