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Java Foundations

5-1

Boolean Expressions and if/else Constructs

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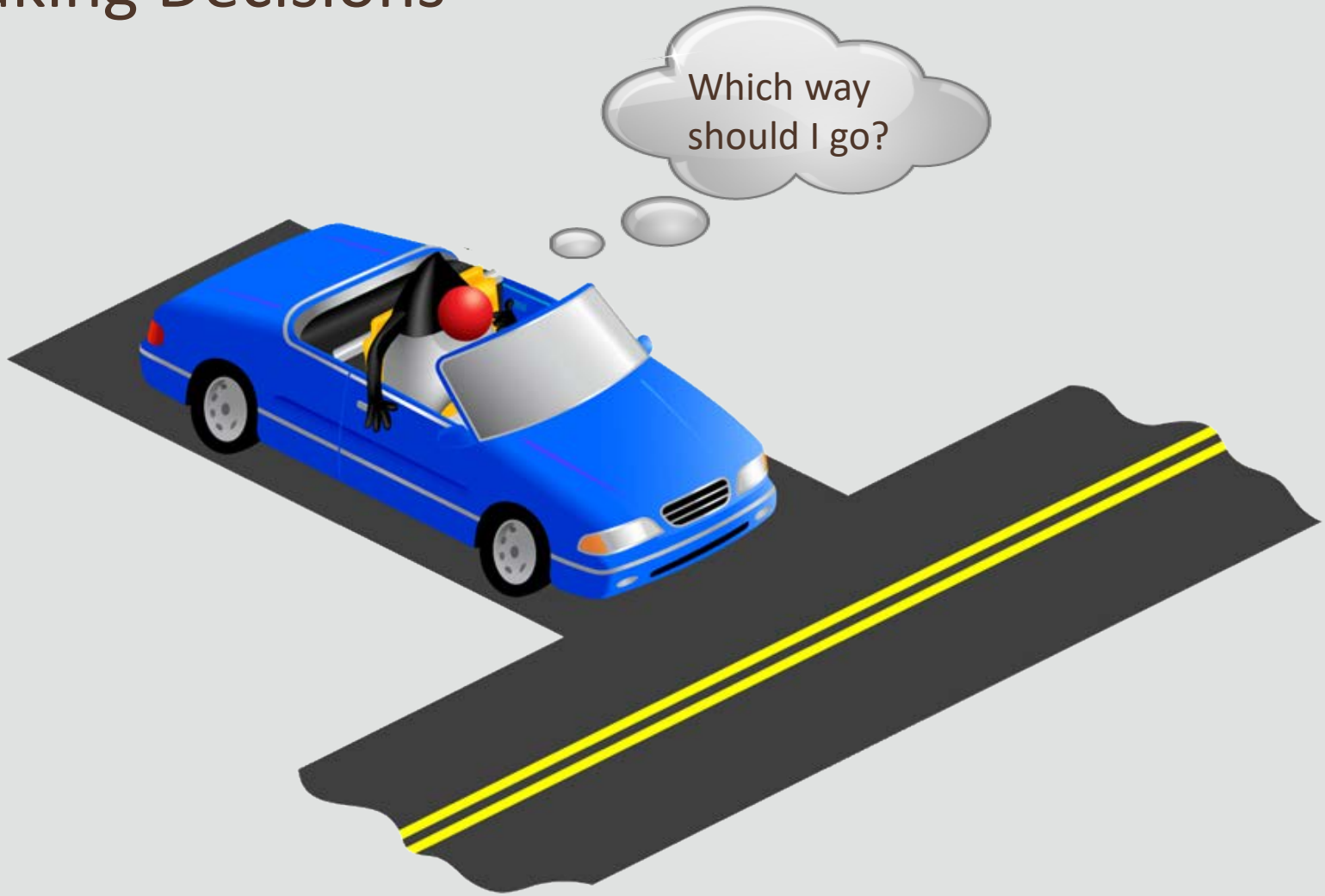
Objectives

- 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

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

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

```
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);
}//end method main
```

Declaring boolean variables

Assigning values to boolean variables

Printing values of boolean variables

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");
}//end method main
```

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);
```

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

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

```
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);
}//end method main
```

For primitive values == checks for equality testing

Exercise 1

- Create a new project and add the `AgeValidity.java` file to the 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

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

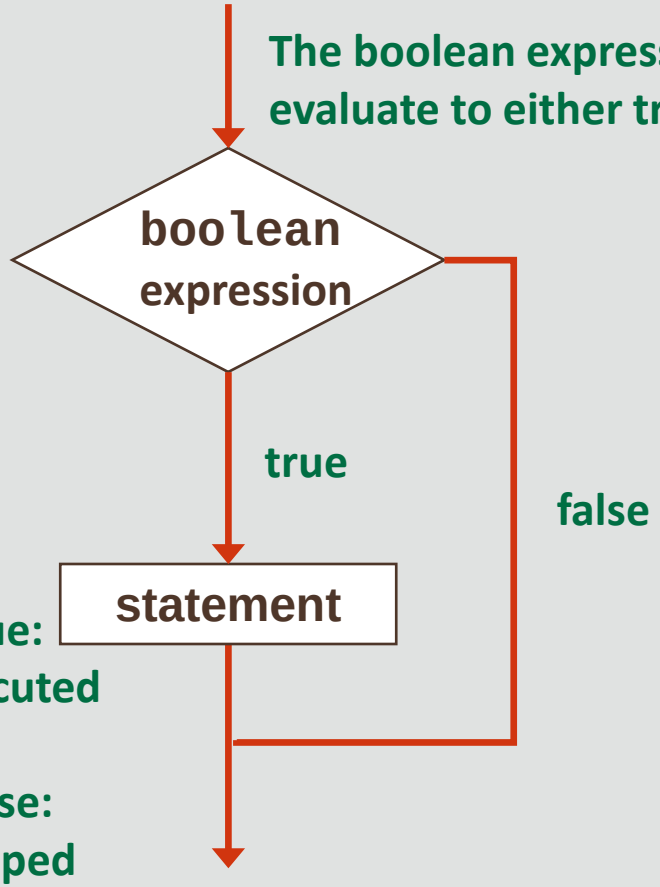
- An if statement consists of a boolean expression followed by one or more statements
- Syntax:

boolean expression

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

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

Understanding the if Statement



If boolean expression is true:
Statement is executed

If boolean expression is false:
Statement is skipped

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");
    }//endif

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

    if (right == "gym") {
        System.out.println("Turn Right");
    }//endif
}//end method main
```

This block is executed

Executing a Block of Code

1. 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 carried out

1

Executing a Block of Code

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

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

2

This block will be executed

if Statement: Examples

```
public static void main(String args[]) {
   int grade = 85;

    if (grade > 88) {
        System.out.println("You made the Honor Roll.");
    } //endif

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

}//end method main
```

Second if statement

- Output:

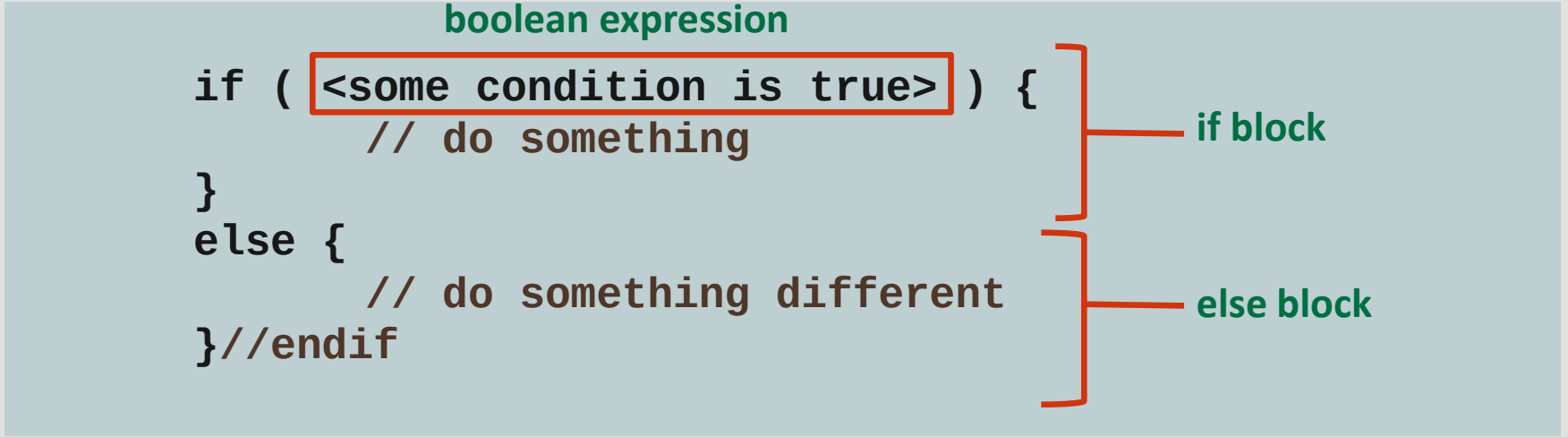
```
You are eligible for tutoring.
```

Exercise 2

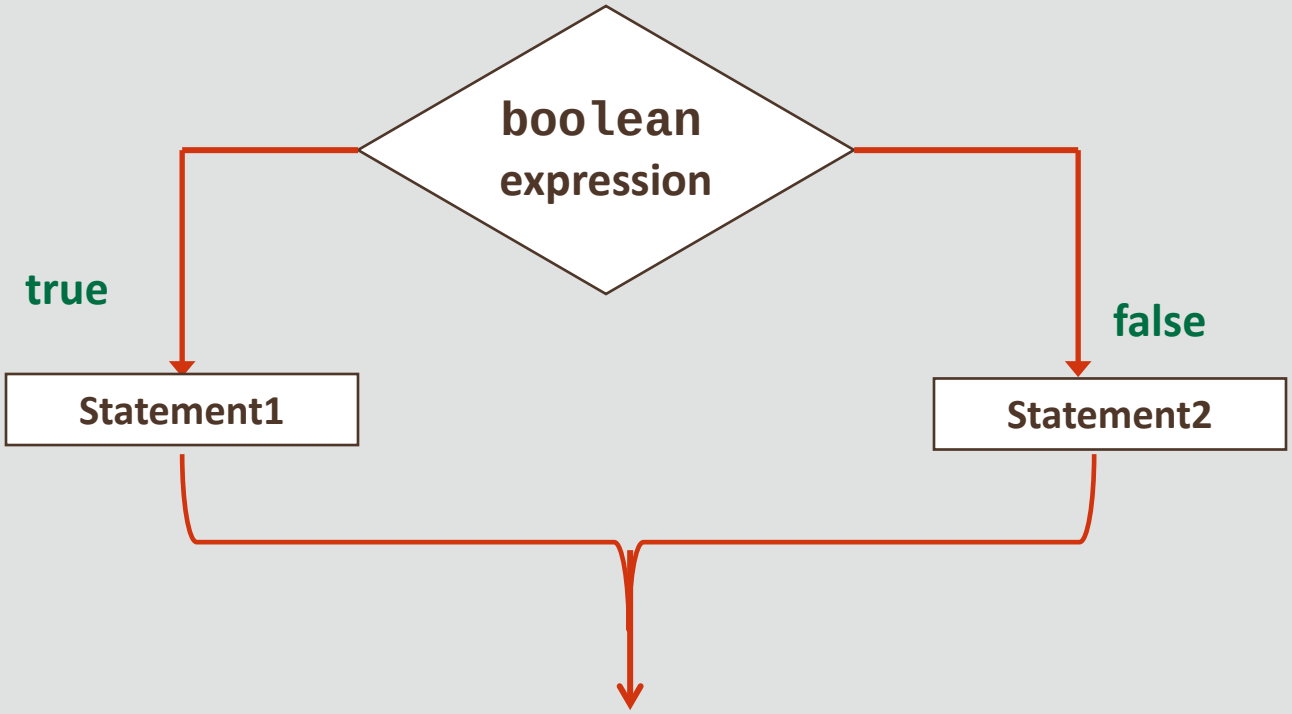
- Add the file `ChkOddEven.java` to the project you created for exercise 1
- Modify the `ChkOddEven.java` to implement the following:
  - Input a number between 1 and 10
  - Use if statements
  - Test whether a number is odd or even
- The program should generate the following output:
  - Enter a number: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

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";
}//endif
```

This block is executed

30.3 °F

if/else Statements: Example 2

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

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

This block is executed

40,2 °F

if/else Statements: Example 3

- 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

```
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.");
    }//endif
}//end method main
```

Exercise 3

- Add the file `AgeCheck.java` to the project you created for exercise 1
- 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

- Add the file `ShoppingCart.java` to the project you created for exercise 1
- 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

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
  - Strings 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 Strings 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

- Add the file `StringEquality.java` to the project you created for exercise 1
- 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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