# 5

# Managing Multiple Items



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# Objectives

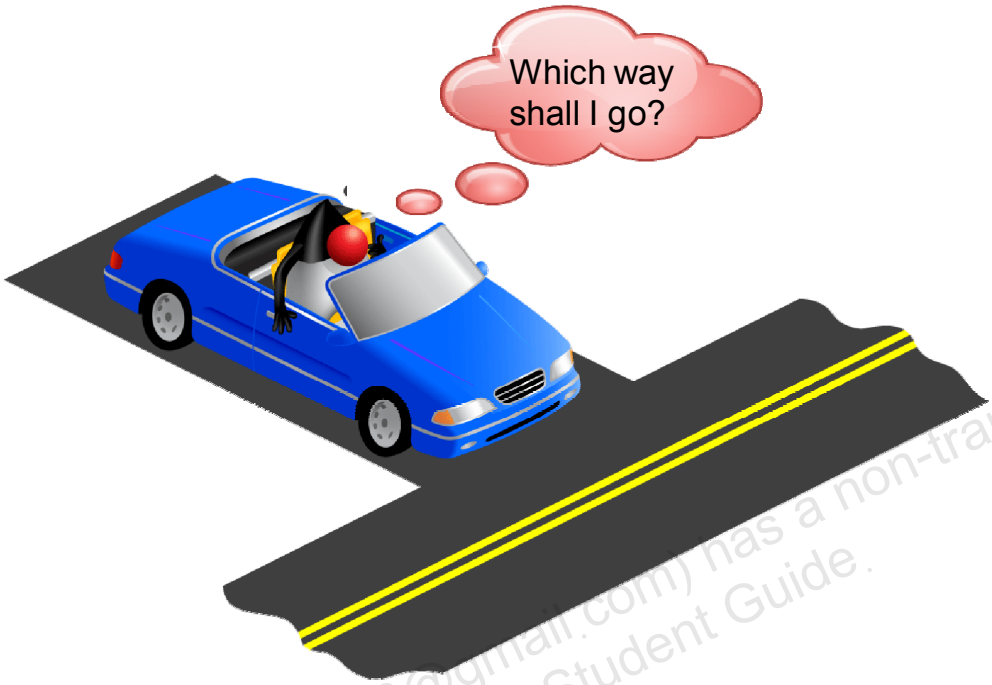
After completing this lesson, you should be able to:

- Explain what a boolean expression is
- Create a simple `if/else` statement
- Describe the purpose of an array
- Declare and initialize a `String` or `int` array
- Access the elements of an array
- Explain the purpose of a `for` loop
- Iterate through a `String` array using a `for` loop

# Topics

- Working with conditions
- Working with an array of items
- Processing an array of items

# Making Decisions





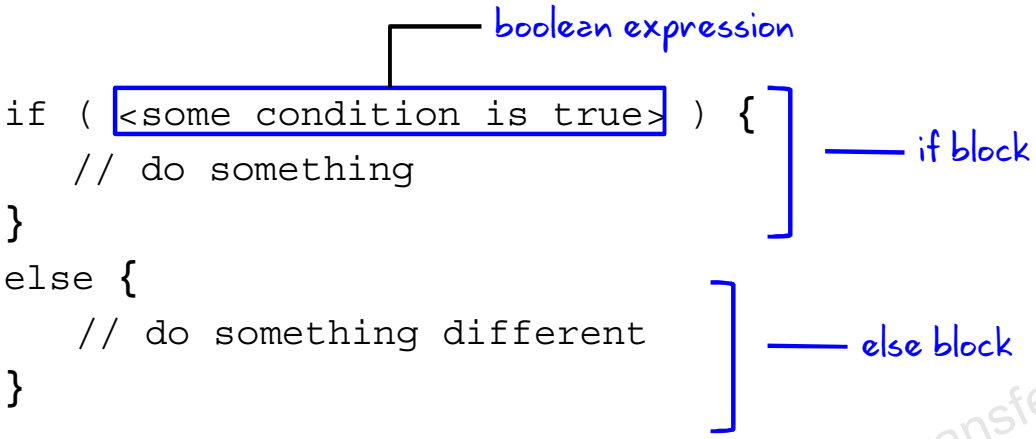





In your daily life, you have to make a lot of decisions, and you often use the word “if” with some condition when making those decisions. For example, “If I can see my destination on the left, I will turn left, otherwise I’ll turn right.”

One of the tasks that programs often perform is to evaluate a condition and, depending on the result, execute different blocks or branches of code. This is called conditional logic, and it is handled through the use of an `if/else` statement.

# The `if/else` Statement






The `if/else` statement is one way of branching your code depending upon some condition. It uses the two Java keywords, `if` and `else`.

- If some condition is true, execute the code within the `if` block.
- Else, if that condition is false, execute the code in the `else` block.

The condition to be evaluated is surrounded by parentheses. It is referred to as a boolean expression because it must evaluate to either `true` or `false`.

# Boolean Expressions

Review:

- `boolean` data type has only two possible values:
  - `true`
  - `false`

A boolean expression is a combination of variables, values, and operators that evaluate to `true` or `false`.

- `length > 10;`
- `size <= maxSize;`
- `total == (cost * price);`

Relational operators



Remember that a `boolean` data type can have only two possible values: `true` and `false`.

In the same way, a boolean expression, made up of some combination of variables, values and operators, must also evaluate to either `true` or `false`.

This usually involves a special kind of operator called a relational operator. Several of these are used in the three examples above:

- Greater than ( > )
- Less than or equal to ( <= )
- Equal to ( == ). In the example above, the result of `cost * price` is compared to the value of `total`. If they are equal, the entire expression evaluates to `true`.

# Relational Operators

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



Here you see a more complete list of relational operators. The table lists the different conditions you can test by using relational operators. The result of all relational operators is a boolean value. All of the examples in the table yield a boolean result of true.

**Note:** The equal sign (=) is used to make an assignment, whereas the == sign merely makes a comparison and returns a boolean.

# Examples

Sometimes there is a quicker way to meet your objective. boolean expressions can be used in many ways.

```
24          int attendees = 4;
25          boolean largeVenue;
26
27          // if statement example
28          if (attendees >= 5){
29              largeVenue = true;
30          }
31          else {
32              largeVenue = false;
33          }
34
35          // same outcome with less code
36          largeVenue = (attendees >= 5);
```

Assign a boolean by using an if statement.

Assign the boolean directly from the boolean expression.



In the slide above, you see examples of two different ways to set the `largeVenue boolean` value:

- In lines 28–33, an `if` statement tests the value of the `attendees` variable. If it is greater than 5, `largeVenue` is set to `true`; otherwise it is set to `false`.
- In line 36, the same outcome is achieved with one line of code. The result of the same boolean expression that was evaluated in the `if` statement (`attendees >=5`) is directly assigned to the `largeVenue boolean`.

# Exercise 5-1: Using `if` Statements

In this exercise, you use an `if` and an `if/else` statement:

- Declare a `boolean`, `outOfStock`.
- `if quantity` > 1
  - Change the `message` variable to indicate plural
- `if/else`:
  - `if` item is out of stock:
    - Inform the user that the item is unavailable
  - `else`
    - Print the `message`
    - Print the total cost



- Open the Java Code Console and access Lessons > 05-ConditionsArraysLoops > Exercise1.
- Follow the instructions below the code editor to write two `if` statements in the main method.

**Note:** If you need help, the solution for this exercise can be found by clicking the Solution link.

# Quiz

What is the purpose of the `else` block in an `if/else` statement?

a. To contain the remainder of the code for a method
b. To contain code that is executed when the expression in an `if` statement is false
c. To test if an expression is false



**Answer: b**

# Topics

- Working with conditions
- Working with an array of items
- Processing an array of items

# What If There Are Multiple Items in the Shopping Cart?

```
01          // Without an array
02          String itemDesc1 = "Shirt";
03          String itemDesc2 = "Trousers";
04          String itemDesc3 = "Scarf";
05
06          // Using an array
07          String[] items = {"Shirt","Trousers","Scarf"};
```

Not realistic if 100s of items!

Much better!



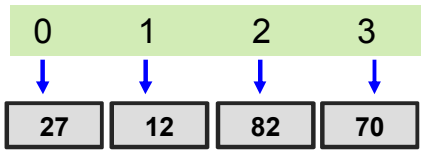
Think about how your code would look if there were multiple items in the shopping cart. You would have to initialize each item description separately. Imagine if you had a thousand items!

As you continued to build out this shopping cart application, the amount of code needed to handle each item individually would not only be time-consuming, but would make your code hard to read and difficult to maintain.

The code example above shows a better alternative that we will explore now: the array.

# Introduction to Arrays

- An array is an indexed container that holds a set of values of a single type.
- Each item in an array is called an *element*.
- Each element is accessed by its numerical index.
- The index of the first element is 0 (zero).
  - A four-element array has indices: 0, 1, 2, 3.






The array is a container that holds a set of `String` values, or a set of `int` values, or a set of `double` values, and so on.

The elements (items) of the array are accessed through a numeric index. Using this index, you can set or get a value from a specific element.

# Array Examples

**Array of `int` types**


**Array of `String` types**

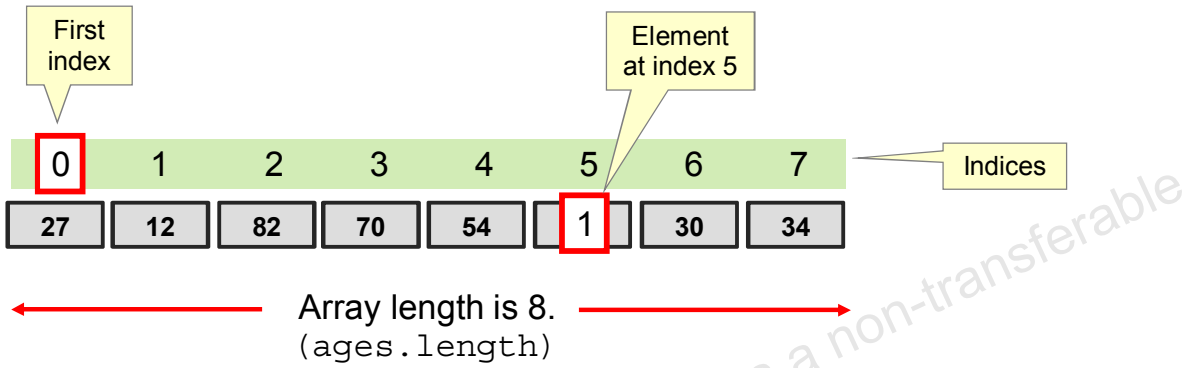



Arrays can be of any data type, but all elements have to share the same type.

# Array Indices and Length



The `ages` array has eight elements.



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- An array is a container object that holds a fixed number of values of a single type. The length of an array is established when the array is created. After creation, the length of an array cannot be changed.
- Each item in an array is called an *element*, and each element is accessed by its numerical index. As shown in the diagram above, index numbering begins with 0. For example, the eighth element would be accessed at index 7.
- The length of an array can be accessed using dot notation to access the `length` field. Assuming that the array in the diagram is called `ages`, you can determine how many elements are in the array by using:

```
int agesLength = ages.length;
```

# Declaring and Initializing an Array

- Syntax:

```
type[] arrayIdentifier = {comma-separated list of values};
```

- Declare arrays of types `String` and `int`:

```
String[] names = {"Mary", "Bob", "Carlos"};
int[] ages = {25, 27, 48};
```

All in one line



In this slide, you see the syntax and an example of how to declare the array and initialize the values. (This assumes that you know at this time what the values will be).

- Syntax for declaring an array:

```
type [] arrayIdentifier = {comma-separated list of values};
```

  - **Note:** Another acceptable syntax is: `type arrayIdentifier[] = {comma-separated list of values};`

where:

- `type` represents the data type for each of the values stored in the array
- `[ ]` informs the compiler that you are declaring an array
- `arrayIdentifier` is the variable name that you use when you refer to the array
- You can list as many values as you need. Separate the values with a comma.

# Declaring and Initializing an Array

- Examples:

```
1    int[] ages = new int[3];
2    ages[0] = 19;
3    ages[1] = 42;
4    ages[2] = 92;
5
6    String[] names = new String[3];
7    names[0] = "Mary";
8    names[1] = "Bob";
9    names[2] = "Carlos";
```

Multistep approach

Multistep approach







In this example, the `int` array, `ages`, is instantiated with a size of 3 on line 1. The creation of the array uses the ***new*** keyword. You will learn much more about the purpose of this keyword in the lesson titled "Describing Objects and Classes."

On lines 2 through 4, the elements of the `ages` array are initialized.

Likewise, on line 6, the `String` array, `names`, is instantiated with a size of 3, and its elements are initialized on lines 7 through 9.

# Accessing Array Elements

- Get values from the `ages` array:

```
int[] ages = {25, 27, 48};

int myAge = ages[0];
int yourAge = ages[1];
System.out.println("My age is " + ages[0]);
```

- Set values from the `names` array:

```
String[] names = {"Mary", "Bob", "Carlos"};

names[0] = "Gary";
names[1] = "Rob";
```



Elements of the array are accessed by referencing the index of that element. For example:

- To get the value from the first element of the `ages` array, use `ages[0]`.
- To get the value from the second element of the `ages` array, use `ages[1]`.
- You can directly use the value of an array element in an expression by using the same syntax. In the third example, you see `ages[0]` referenced directly when calling `System.out.println`.
- To set a value in the first element of the `names` array, use `names[0] = "some value"`.

# Exercise 5-2: Using an Array

In this exercise, you declare and initialize a `String` array to hold names. Then you experiment with accessing the array:

- Declare a `String` array, `names`, and initialize it with four `String` values.
- Print the number of items the customer wants to buy.
- Print one of the array elements.



- Open the Java Code Console and access Lessons > 05-ConditionsLoopsArrays > Exercise2
- In the `ShoppingCart` class, follow the instructions below the code editor to:
  - Declare and initialize a `String` array to hold four distinct `String` values.
  - Change the `message` variable to reflect not only the customer name, but a message that includes the number of items the customer wants to purchase. (**Hint:** Use the `length` property of the array.)
  - Print the `message`.
  - Print the third element of the `names` array.
  - Run the file.
  - Change the element index number in the print statement to 4 and run the file again. You will get an error. Why?

**Note:** If you need help, the solution for this exercise can be found by the clicking the Solution link.

# Quiz

Why does the following code not compile? Select all that apply.

```
int[] lengths = {2, 4, 3.5, 0, 40.04};
```

a. `lengths` cannot be used as an array identifier.

b. All of the element values should have the same format (all using `double` values, or all using `int` values).

c. The array was declared to hold `int` values. `double` values are not allowed.







**Answer: c**

a is incorrect because `lengths` is a perfectly valid array identifier.

b is incorrect because it implies that this array could contain elements of type `double`.

c is correct.

# Quiz

Given the following array declaration, which of the following statements are true?

```
int[] classSize = {5, 8, 0, 14, 194};
```

a. `classSize[0]` is the reference to the first element in the array.

b. `classSize[5]` is the reference to the last element in the array.

c. There are 5 integers in the `classSize` array.

d. `classSize.length = 5`







**Answer: a, c, d**

a is correct.

b is incorrect because the array index begins with 0. Thus, the index for the last element is one less than the total number of elements.

c is correct.

d is correct.

# Topics

- Working with conditions
- Working with an array of items
- Processing an array of items

# Loops

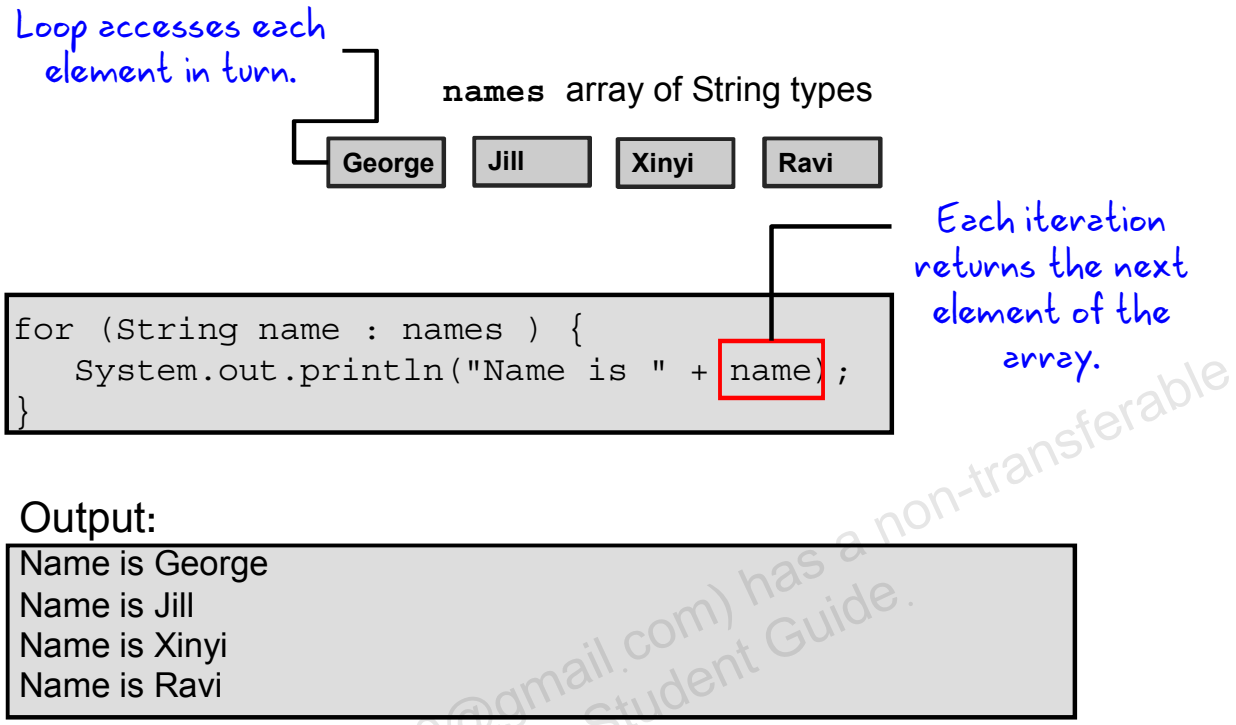
Loops are used in programs to repeat blocks of statements

- Until an expression is false

  or

- For a specific number of times:
  - I want to print each element of an array.
  - I want to print each element of an `ArrayList`. (The `ArrayList` class is covered in the lesson titled “Working with Arrays, Loops, and Dates.”

# Processing a String Array






The `for` loop syntax is:

```
for (<type> <variable> : <array name>) {
        <code_block to be performed for each array element>
}
```

where:

- `for` indicates that a loop is being defined
- `<type>` is the data type of each of the elements within the array
- `<variable>` is a placeholder used to store each element of an array
- `:` indicates that the object reference that follows is an array
- `<array name>` is the array, whose length determines the number of iterations to perform
- `code_block` is the code that will be executed in each iteration of the loop

In the example above, there are four elements in the `names` array. Therefore, the code block will be executed four times. Each time, the `name` variable holds a different array element.

# Using `break` with Loops

`break` example:

```
01  int passmark = 12;
02  boolean passed = false;
03  int[] scores = {4,6,2,8,12,35,9};
04  for (int unitScore : scores){
05      if (unitScore >= 12){
06          passed = true;
07          break;
08      }
09  }
10  System.out.println("At least one passed? " +passed);
```

No need to go through the loop again, so use break.

Output:

```
At least one passed? true
```



Occasionally, some condition occurs that makes it unnecessary to continue the loop. The `break` keyword enables you to do this. When `break` is encountered, the program execution moves to the first line of code outside the `for` block.

- The example in the slide shows the use of `break`. You will notice that it uses an `if` statement within the `for` block. This `if` statement is executed on each iteration of the loop.
- Assuming that the purpose of the code is to find out whether any of the scores in the array are equal or above the `passmark`, you can set `passed` to `true` and jump out of the loop as soon as the first such score is found.
- When `break` is called on line 7, execution of the program skips to line 10.

# Exercise 5-3: Using a Loop to Process an Array

In this exercise, you loop through an array called `itemPrices` to print a message indicating each item price.



- Open the Java Code Console and access Lessons > 05-ConditionsLoopsArrays > Exercise3
- Follow the instructions below the code editor to process the itemPrices array.

**Note:** If you need help, the solution for this exercise can be found by clicking the Solution link.

# Quiz

Given the following code,

```
int[] sizes = {4, 18, 5, 20};
for (int size : sizes){
    if (size > 16){break;}
    System.out.println("Size: "+size + ", ");
}
```

which option below shows the correct output?

a. `Size: 4,`

b. `Size: 4`

c. `Size: 4,`
`Size: 5,`

d. There is no output.



**Answer: a**

a is correct.

b is incorrect because the comma appears within each `println` method.

c is incorrect because when the first size greater than 16 is found, the loop breaks and does not return.

d is incorrect because the first iteration of the loop would print.

# Summary

In this lesson, you should have learned how to:

- Use a boolean expression
- Create a simple `if/else` block
- Describe the purpose of an array
- Declare and initialize a `String` or `int` array
- Access the elements of an array
- Explain the purpose of a `for` loop
- Iterate through a `String` Array using a `for` loop

# Play Time!

Basic.05 is most important.

Play **Basic Puzzles 1 through 5** before the lesson titled "Describing Objects and Classes."

Your Goal: Design a solution that deflects the ball to Duke.

Consider the following:

What happens when you put a triangle wall or simple wall icon on the blue wheel?



You are welcome to play beyond Basic Puzzle 5. Puzzles beyond Basic.05 are associated with later lessons.

# About Java Puzzle Ball

- It is used throughout the course.
- Play a set of puzzles.
- Become familiar with the game mechanics.
- Consider a question as you play.
- The lesson titled “Describing Objects and Classes” debriefs on what you have observed.
- Apply your observations to understand Java concepts.



At certain points throughout the course, you will be asked to play levels of Java Puzzle Ball. The game reflects Java concepts through game mechanics. It's more important to become familiar with these mechanics than it is to solve every puzzle. Don't worry if the connection between game mechanics and Java concepts is not immediately apparent. You will debrief in future slides and realize the connection during this debriefing. As you develop an understanding for how the game works, you will be able to apply what you have learned as a foundation for understanding difficult Java concepts.

# Tips

- You must have Java 8 installed to run the game.
- The game may perform better on your personal machine.