Data in a Cart

Objectives

After completing this lesson, you should be able to:

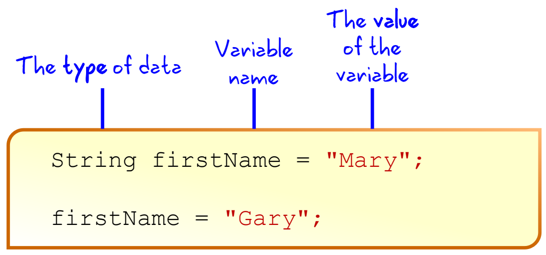
- Describe the purpose of a variable in the Java language
- List and describe four data types
- Declare and initialize `String` variables
- Concatenate `String` variables with the '+' operator
- Make variable assignments
- Declare and initialize `int` and `double` variables
- Modify variable values by using numeric operators
- Override default operator precedence using ( )

Topics

- Introducing variables
- Working with `String` variables
- Working with numbers
- Manipulating numeric data

Variables

- A variable refers to something that can change.
  - Variables can be initiated with a value.
  - The value can be changed.
  - A variable holds a specific type of data.



```
String firstName = "Mary";

firstName = "Gary";
```

A variable is simply a storage location in memory that holds a specific value. That value can be changed by copying (or “assigning”) a different value to that variable.

Variable Types

- Some of the types of values a variable can hold:
  - `String` (example: "Hello")
  - `int` (examples: -10, 0, 2, 10000)
  - `double` (examples: 2.00, 99.99, -2042.00009)
  - `boolean` (true or false)
- If uninitialized, variables have a default value:
  - `String:` null
  - `int:` 0
  - `double:` 0.0
  - `boolean:` false

Variables are declared to hold a specific type of data. Some of the more common types are:

- `String`: This is text data, such as “Hello”.
- `int`: This is integer data—positive or negative whole numbers.
- `double`: These are positive or negative *real* numbers containing a decimal portion.
- `boolean`: This data type has a value of either true or false.

Most variables that have not been initialized are given a default value. The default values for String, `int`, `double`, and `boolean` are shown above. (Local variables are the exception. You will learn about local variables in the lesson titled “Creating and Using Methods.”)

Notice that `String` begins with an uppercase letter, but the other types do not. You will learn the reason for this later, when you also learn about some other data types.

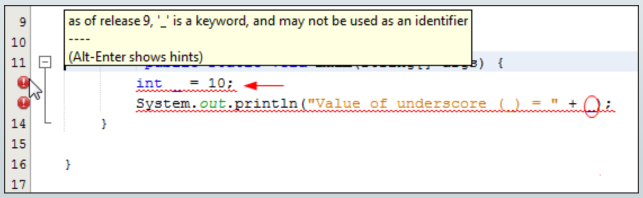
Naming a Variable

Guidelines:

- Begin each variable with a lowercase letter. Subsequent words should be capitalized:
  - `myVariable`
- Names are case-sensitive.
- Names cannot include white space.
- Choose names that are mnemonic and that indicate to the casual observer the intent of the variable.
  - `outOfStock    (a boolean)`
  - `itemDescription   (a String)`

Java SE 9: The Underscore Character Is Not a Legal Name

- If you use the underscore character ("_") as a one-character identifier in source code, then your code won't compile in Java SE 9.
- For example:



as of release 9, '_' is a keyword, and may not be used as an identifier
----
(Alt-Enter shows hints)

```
        int _ = 10;
        System.out.println("Value of underscore (_) = " + _);
    }

}
```

Using underscore as a identifier generates a warning in JDK 8 and an error in Java SE 9.

Uses of Variables

- Holding data used within a method:

```
String name = "Sam" ;
double price = 12.35;
boolean outOfStock = true;
```

- Assigning the value of one variable to another:

```
String name = name1;
```

- Representing values within a mathematical expression:

```
total = quantity * price ;
```

- Printing the values to the screen:

```
System.out.println(name);
```

Variables are used extensively in the Java programming language for tasks such as:

- Holding data used within a method, such as the `main` method
- Assigning the value of one variable to another. In the first example above, the `name` variable is initialized with the value, "Sam", and in the second example, its value is changed to the value of `name1` (unknown here).
- Representing values within a mathematical expression (* is the symbol for multiplication)
- Printing the values to the screen. For example, the same `System.out.println` method that you used in the last exercise to print out the text literal, "Welcome to the Shopping Cart", can also be used to print out the value stored in the `name` variable.

Topics

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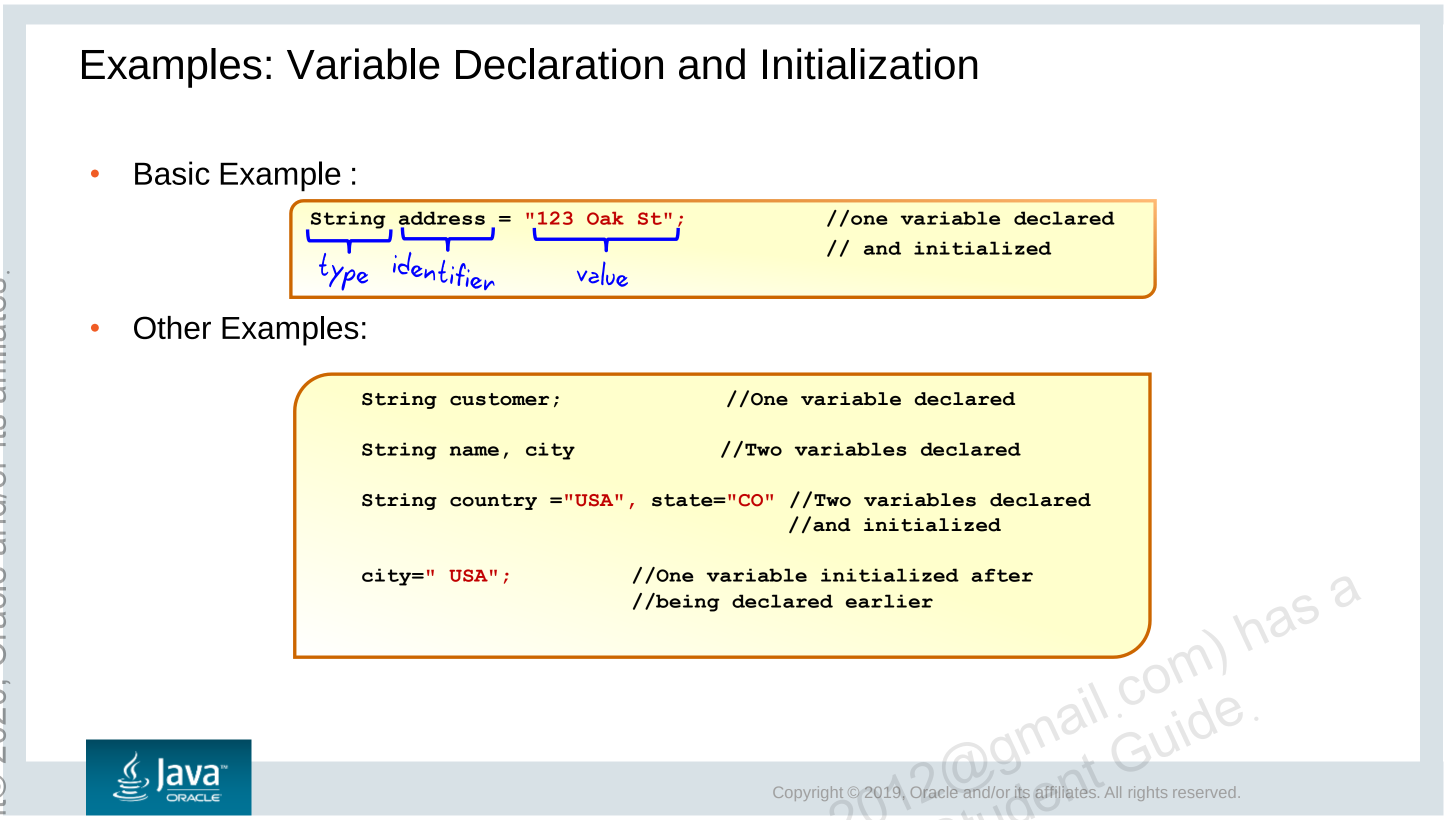

Examples: Variable Declaration and Initialization

- Basic Example :

```
String address = "123 Oak St";          //one variable declared
                                         // and initialized
```

type identifier value

- Other Examples:

```
String customer;              //One variable declared

String name, city            //Two variables declared

String country ="USA", state="CO" //Two variables declared
                                  //and initialized

city=" USA";          //One variable initialized after
                      //being declared earlier
```

The syntax for declaring and initializing a variable is:

```
type identifier [= value];
```

where:

- **`type`** represents the type of information or data held by the variable. In the examples in the slide, you see only `String` variable types declared.
- **`identifier`** is the variable name. In the first example in the slide, the variable name is `customer`.

The second example shows how you can declare any number of variables of the same type on a single line without initializing them. Notice that when declaring multiple variables in a single line, they are separated by a comma.

You can either declare a variable without assigning an initial or you can initialize the variable at the same time you declare it.

`String` Concatenation

- `String` variables can be combined using the '+' operator.
  - `stringVariable1 + stringVariable2`
  - `stringVariable1 + "String literal"`
  - `stringVariable1 + "String literal" + stringVariable2`

- Example:

```
String greet1 = "Hello";
String greet2 = "World";
String message = greet1 + " " + greet2 + "!";
String message = greet1 + " " + greet2 + " " + 2014 +"!";
```

Combining multiple Strings is called "concatenation." You can concatenate a `String` variable to another `String` variable. You can also concatenate a `String` literal to a `String` variable.

As you can see in the example above, you can concatenate any number of `String` variables and `String` literals to achieve your goal.

You may find the last example surprising. You can also concatenate a number into a `String` variable. The compiler converts the numeric value to its equivalent `String` value. If we were to print the `message` variable after the last example, the output would be "Hello World 2014!"

String Concatenation

You can concatenate String variables outside or inside a method call:

```
String greet1 = "Hello";
String greet2 = "World";
String message = greet1 + " " +greet2  + "!";

System.out.println(message);
System.out.println(greet1 + " " + greet2 + "!");
```

Output:

```
    Hello World!
    Hello World!
```

In the examples in the slide, you see two variations of printing out String data by using the System.out.println method.

- In the first example, the message variable will be printed.
- In the second example, the expression containing the concatenation of variables plus String literals can be used within the method parentheses. The concatenation will be completed by the runtime engine before the println method is executed.
- As you can see, the output of both method invocations is the same.

Exercise 4-1: Using `String` Variables

1. In NetBeans, open the project **`Exercise_04-1`**.
2. Declare and initialize two String variables: `custName` and `itemDesc`.
3. Declare a String variable called `message`. Do not initialize it.
4. Assign the `message` variable with a concatenation of the `custName` and `itemDesc`. Include a String literal that results in a complete sentence.
   - Example: "Mary Smith wants to purchase a Shirt"
5. Print `message` to the System output.

In this exercise, you declare, initialize, and concatenate String variables and literals.

Quiz

Which of the following variable declarations and/or initializations are correct?

```
a. int count = 5; quantity = 2;
b. string name, label;
c. boolean complete = "false";
d. boolean complete = true;
```

Answer: d

- a is incorrect because each `int` declaration and assignment must be separated by a comma and not a semicolon.
- b is incorrect because `String` is not capitalized.
- c is incorrect because a `boolean` type variable does not hold `String` values. It holds only `true` and `false`.
- d is correct.

Topics

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`int` and `double` Values

- `int` variables hold whole number values between:
  - `-2,147,483,648`
  - `2,147,483,647`
  - Examples: 2, 1343387, 1_343_387
- `double` variables hold larger values containing decimal portions.
  - Use when greater accuracy is needed.
  - Examples: 987640059602230.7645 , -1111, 2.1E12

- The `int` data type stores 32 bits of data. This means that you can store whole numbers within the range: -2,145,483,648 and 2,147,483,647. You cannot use commas to make the number more readable when you assign a value to an `int` variable. However, you can use underscores (_) to make your code more readable, as shown in one of above `int` examples. The compiler ignores these underscores. If you print the number to system output, the underscores will not appear. The only benefit of this is readability in your code.
- The `double` data type stores 64 bits of data. This means that you can store extremely large values—either negative or positive. The examples above show:
  - An extremely large number with four decimal points of precision
  - A negative whole number
  - A decimal number using exponential notation

Initializing and Assigning Numeric Values

- `int` variables:
  - `int quantity = 10;` ✓
  - `int quantity = 5.5;` ⊘ Compilation fails!

- `double` variables:
  - `double price = 25.99;` ✓
  - `double price = 75;` ✓ Run time will interpret as 75.0.

Topics

- Introducing variables
- Working with `String` variables
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Standard Mathematical Operators

Purpose	Operator	Example	Comments
Addition	`+`	`sum = num1 + num2;`	If num1 is 10 and num2 is 2, sum is 12.
Subtraction	`–`	`diff = num1 – num2;`	If num1 is 10 and num2 is 2, diff is 8.
Multiplication	`*`	`prod = num1 * num2;`	If num1 is 10 and num2 is 2, prod is 20.
Division	`/`	`quot = num1 / num2;`	If num1 is 31 and num2 is 6, quot is 5. The remainder portion is discarded. Division by 0 throws an exception.

The table above assumes that all operands and result variables are integers (`int`). Mixing `double` and `int` types can alter the results. For instance, in the division example, if the quotient and dividend (or if all three) are `double` values, the quotient would show the decimal portion:

```
double quot, num1;
num1 = 31;
int num2 = 5;
quot = num1 / num2;
```

Answer: `quot = 6.2`

With floating points(float) operands division by zero doesn't throw an exception and +Infinity or -Infinity values are represented

For example:

```
float a=0.0f;
    float b=6.5f;
    float res= b/a;
    System.out.print(res);
```

This displays Infinity.

Increment and Decrement Operators (++ and −−)

The long way:

```
age = age + 1;
```

or

```
count = count – 1;
```

The short way:

```
age++;
```

or

```
count--;
```

A common requirement in programs is to add or subtract 1 from the value of a variable. You can do this by using the + operator as follows:

```
age = age + 1;
```

Operator Precedence

Here’s an example of the need for rules of precedence.

Is the answer to the following problem 34 or 9?

```
int c = 25 - 5 * 4 / 2 - 10 + 4;
```

Operator Precedence

Rules of precedence:

1. Operators within a pair of parentheses
2. Increment and decrement operators (++ or --)
3. Multiplication and division operators, evaluated from left to right
4. Addition and subtraction operators, evaluated from left to right

In a complex mathematical statement with multiple operators on the same line, how does the computer pick which operator it should use first? To make mathematical operations consistent, the Java programming language follows the standard mathematical rules for operator precedence. Operators are processed in the following order:

1. Operators within a pair of parentheses
2. Increment and decrement operators
3. Multiplication and division operators, evaluated from left to right
4. Addition and subtraction operators, evaluated from left to right

If standard mathematical operators of the same precedence appear successively in a statement, the operators are evaluated from left to right.

Using Parentheses

Examples:

```
int c = (((25 - 5) * 4) / (2 - 10)) + 4;
int c = ((20 * 4) / (2 - 10)) + 4;
int c = (80 / (2 - 10)) + 4;
int c = (80 / -8) + 4;
int c = -10 + 4;
int c = -6;
```

Your expression will be automatically evaluated with the rules of precedence. However, you should use parentheses to provide the structure you intend:

```
int c = (((25 - 5) * 4) / (2 - 10)) + 4;
int c = ((20 * 4) / (2 - 10)) + 4;
int c = (80 / (2 - 10)) + 4;
int c = (80 / -8) + 4;
int c = -10 + 4;
int c = -6;
```

Exercise 4-2: Using and Manipulating Numbers

1. Continue editing **`Exercise_04-1`** or open **`Exercise_04-2`**.
2. Declare and initialize numeric fields: `price` (double) `tax` (double), and `quantity` (int). Also declare a double called `total`, but do not initialize it.
3. Change the `message` variable to include `quantity`
   – Example: "Mary Smith wants to purchase 1 Shirt.“
4. Calculate total by multiplying price * quantity * tax.
5. Print a message showing the total cost (example: "Total cost with tax is: 25.78.").

In this exercise, you declare and initialize numeric variables, and concatenate Strings with numbers.

Quiz

Which of the following statements are correct Java code?

```
a. int count = 11.4;
b. double amount = 11.05;
c. int cost = 133_452_667;
d. double total = 1.05 * amount;
```

Answer: b, c, d

- a is incorrect because the assignment of a decimal value to an `int` is a possible loss of precision and therefore will not compile.
- b is correct.
- c is correct because underscores can be used to make a number more readable.
- d is correct.

Quiz

Given:

```
String name = "Bob";
String msg;
int num = 3;
```

Which of the following statements correctly assigns the value “Bob wrote 3 Java programs.” to the msg variable?

```
a. msg = name + " wrote " + num " Java programs.";
b. msg = name + " wrote " + 3 + " Java programs.";
c. msg = "Bob wrote "+ (2+1) + " Java programs.";
d. msg = name + " wrote " + 2+1 + " Java programs.";
```

Answer: b, c

- a is incorrect because it is missing a + sign between the num variable and the final `String` literal.
- b is correct because the compiler converts the `int` of value 3 to a `String`.
- c is correct because, due to the use of parentheses, the addition operation is performed first, before the concatenation.
- d is incorrect because it would result in “Bob wrote 21 Java programs.” The compiler converts each number to a `String` separately and concatenates them together.

Summary

In this lesson, you should have learned how to:

- Describe the purpose of a variable in the Java language
- List and describe four data types
- Declare and initialize `String` variables
- Concatenate `String` variables with the '+' operator
- Make variable assignments
- Declare and initialize `int` and `double` variables
- Modify numeric values by using operators
- Override default operator precedence using ( )