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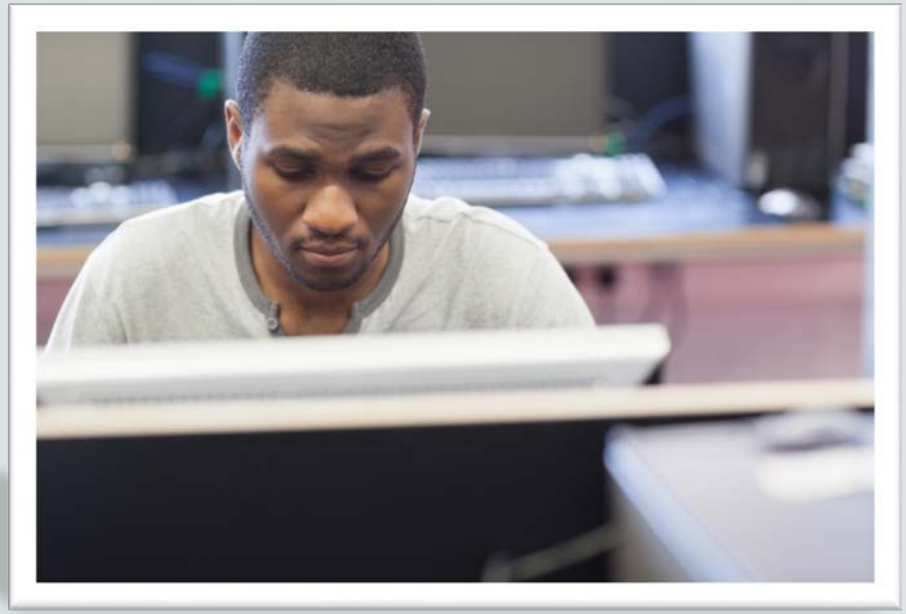
Java Fundamentals

4-2
Object and Driver Classes



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Objectives

This lesson covers the following objectives:

- Describe the general form of a Java program
- Describe the difference between an Object class and a Driver class
- Access a minimum of two Java class APIs
- Explain and give examples of Java keywords
- Create an Object class
- Create a Driver class

General Java Program Form

- There are two general forms of Java classes:
  - Driver classes
  - Object classes

Driver Classes

- Driver classes:
  - Contain a main method.
    - A main method is necessary to run a Java program in Eclipse.
    - The main method may include:
      - Instances of objects from an object class
      - Variables
      - Loops, conditional statements (if-else)
      - Other programming logic
  - Can also contain other static methods.

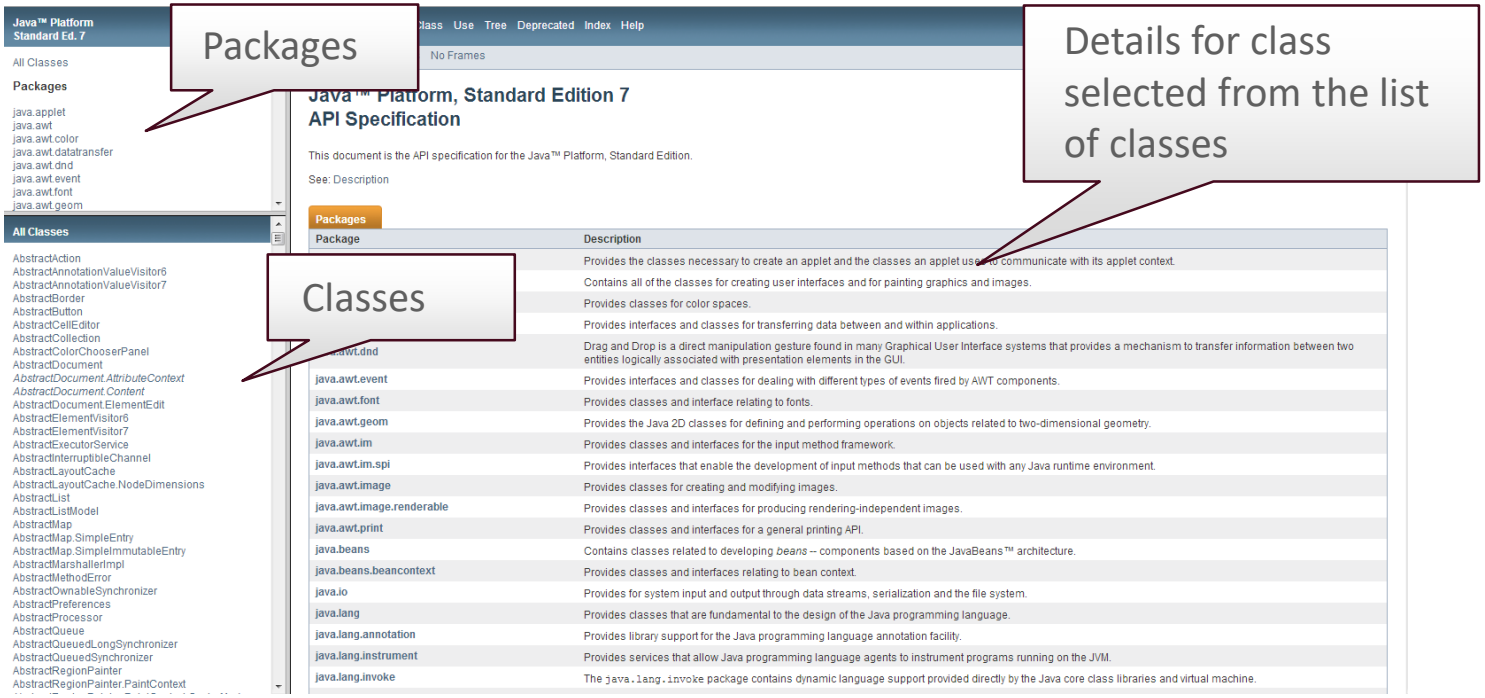
Object Classes

- Object classes:
  - Are classes that define objects to be used in a driver class.
  - Can be found in the Java API, or created by you.
  - Examples: String, BankAccount, Student, Rectangle

The Java API is a library of packages and object classes that are already written and are available for use in your programs.

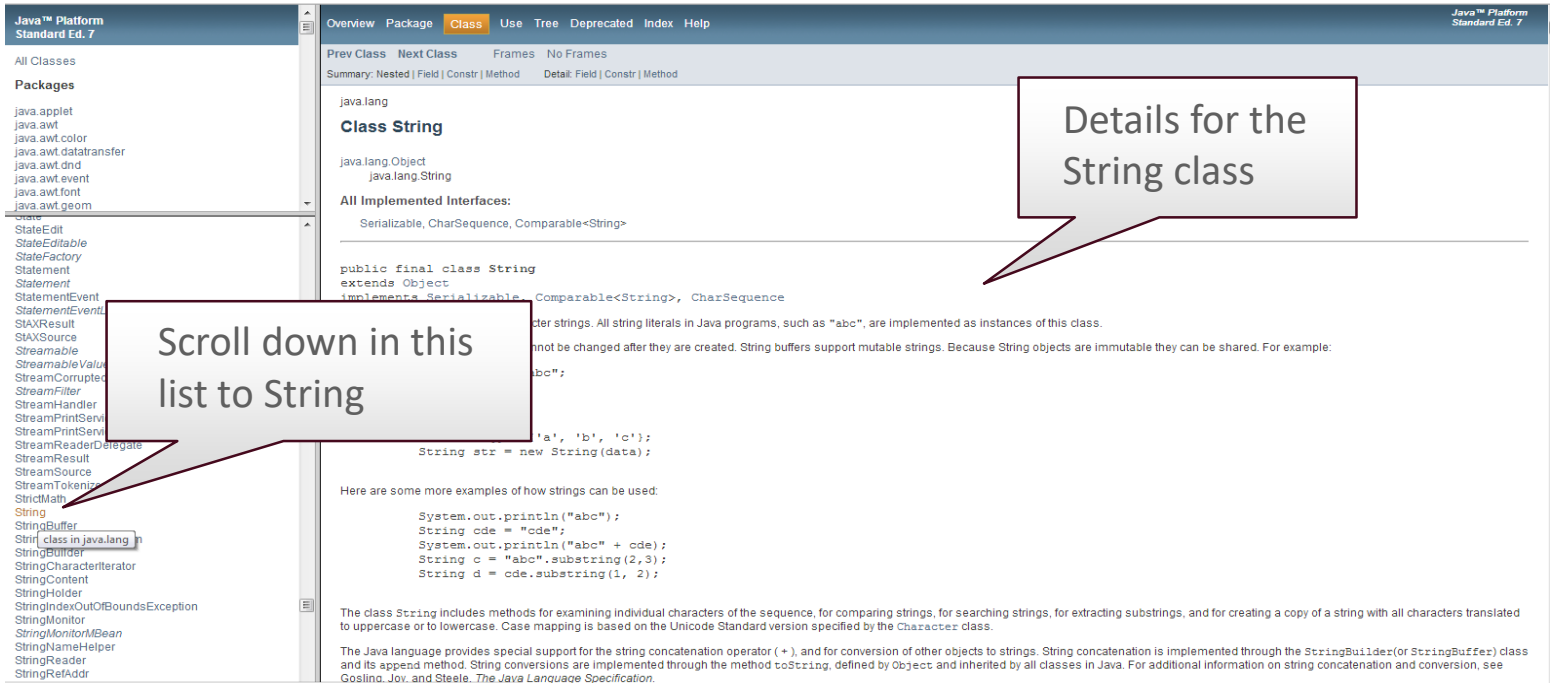
The Java API

- The Java API documentation is located here:
  - http://docs.oracle.com/javase/7/docs/api/



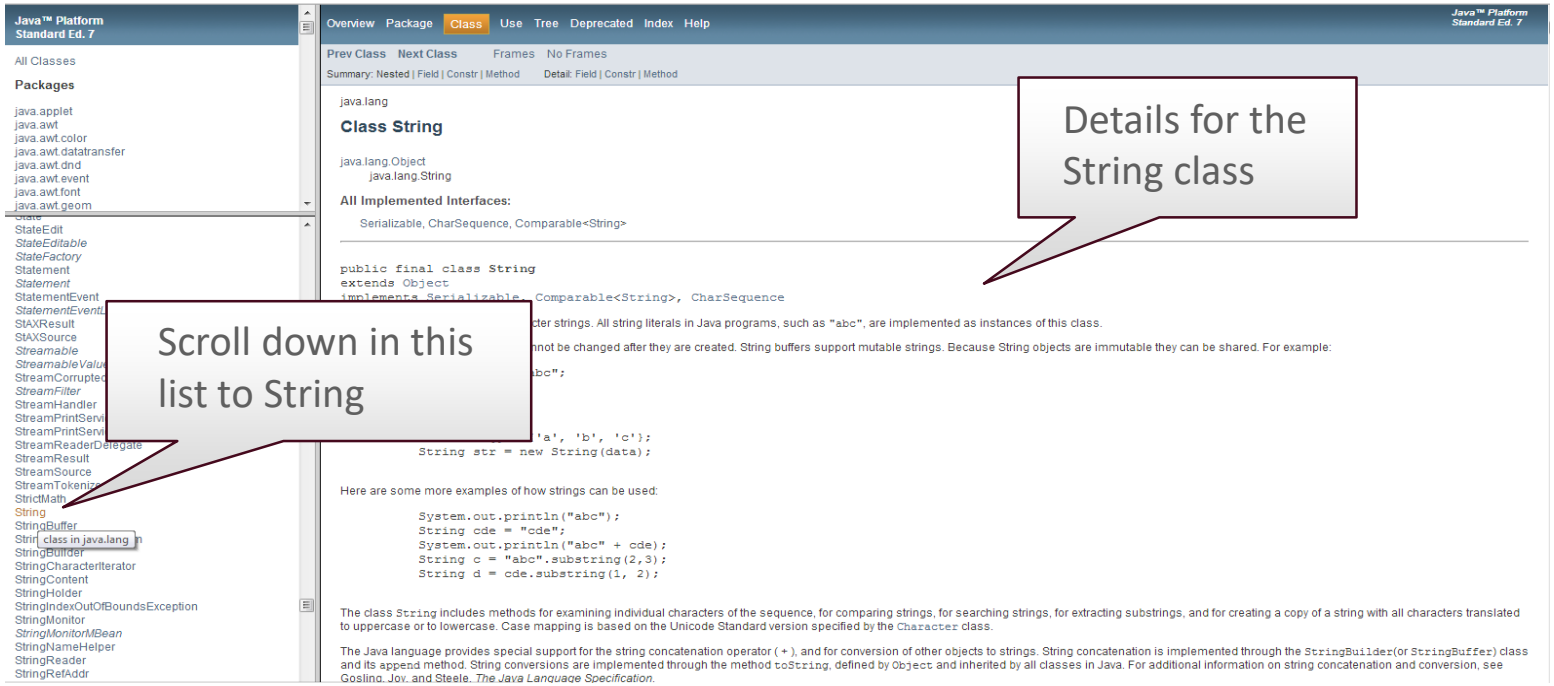
The Java API: String Class

- Scroll through the list of classes until you see String, then click on the link. You should see the following:



The Java API: Examine String Class

- Examine and discuss the constructors and methods.



The Java API: The String Class

- We will use the String class in programs.
- The constructor that is most common for this class is:
  - String(String original)
- Common Methods include:

Method	Description
charAt(int index)	Returns the char value at the specified index.
length()	Returns the length of this string.
substring(int beginIndex)	Returns a new string that is a substring of this string.

A Simple Programmer-Created Object Class: Student

- A Java class is used to store or represent data for the object that the class represents.
- There are many classes already available from the Java API, but you will want to create many more.
- For example, we can create a model, or programmatic representation, of a Student.
- Information that we might need for a student includes Student Id, Name, and GPA.
- In this lesson, we will create a Object class called Student, then a Driver class called StudentTester.

A Simple Programmer-Created Object Class: Student

- All Java classes are created in a text file with the same name as the class.
- These files also have a .java extension.
- In this lesson, we will create a Student class and a StudentTester class in Eclipse.

Syntax to Create A Simple Programmer-Created Object Class

- The following is example syntax to create a programmer-created object class.
- The Java keywords are:
  - package (optional)
  - import (optional)
  - public class

```
package <package_name>;
import <other_packages>;

public class ClassName
    {
       <variables (also known as fields)>;
       <constructor method(s)>;
       <other methods>;
    }
```

Key Terms

Term	Definition
package keyword	• Defines where this class lives relative to other classes, and provides a level of access control. • Use access modifiers (such as public and private) to control access.
import keyword	• Defines other classes or groups of classes that you are using in your class. • The import statement provides the compiler information that identifies outside classes used within the current class.
class keyword	• Precedes the name of the class. • The name of the class and the file name must match when the class is declared public (which is a good practice). However, the keyword public in front of the class keyword is a modifier and is not required.
class variables or instance fields (often shortened to *fields*)	• Variables, or the data associated with programs (such as integers, strings, arrays, and references to other objects).

Key Terms

Term	Definition
Constructors	• Methods called during the creation (instantiation) of an object (a representation in memory of a Java class.)
Methods	• Methods that can be performed on an object. They are also referred to as instance methods. Methods may return an object's variable values (sometimes called functions) or they may change an object's variable values.

Java Keywords

- All Java programs use Java keywords.
- Examples include the following words: class, public, String, int, for, while, and double.
- The font color for Keywords will change in the Eclipse editor.
- List of Java keywords:
  - http://docs.oracle.com/javase/tutorial/java/nutsandbolts/_keywords.html

A Java keyword is a word that has a special function in the Java language, and cannot be used as names for classes, methods, or variables.

Java Program Naming Conventions

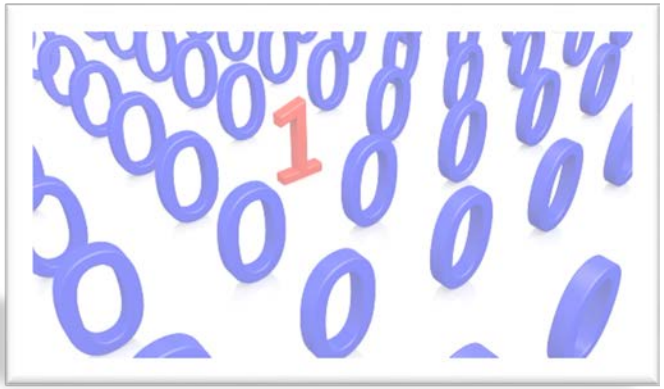
- Naming Conventions for a Java program:
  - The optional package name is defined before an import statement in lower camel case.
  - The optional import statements are defined below the package name.
  - The class name is a noun labeled using upper camel case.

Camel Case

- Camel case is the practice of stringing capitalized words together with no spaces.
- Lower camel case strings capitalized words together but the lead word is not capitalized.
- For example: thisIsLowerCamelCase.
- Upper camel case strings capitalized words together, but the lead word is capitalized.
- For example: ThisIsUpperCamelCase.

Additional Naming Conventions for a Java Program

- Additional naming conventions for a Java program:
  - Variable names are short but meaningful in lower camel case.
  - Constant names are declared in uppercase letters with the final modifier.
  - Constructors are named the same as the class name.
  - Methods are verbs named in lower camel case.



Naming Conventions Example

- The guidelines for a programmer-created object class are labeled in this example for Student.
- Create this file in Eclipse. // is the symbol for comments.

```
package com.example.domain;  // Package Declaration
import java.util.Scanner;// An Import Statement for other packages
public class Student // Class Declaration for this file
    {
       private int studentId;           // Variable Declarations for this class
       private String name;
       private String ssn;
       private double gpa;
       public final int SCHCODE = 34958// A Constant Declaration
       public Student(){// A Constructor
}
       public int getStudentId(){// An accessor Method
          return studentId;
       }
       public void setStudentId(int x){ // A mutator Method
          studentId = x;
       }
    }
```

A Simple Programmer-Created Object Class: Student

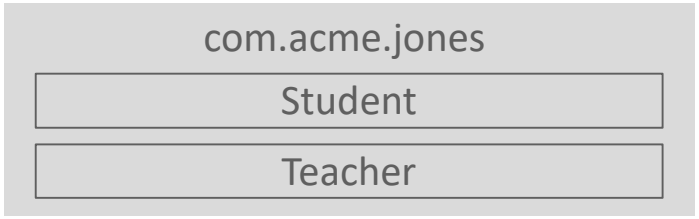
- The optional package keyword is used in Java to group classes together.
  - A package is implemented as a folder. Like a folder, it provides a namespace to a class.
  - It is recommended to always declare a package at the top of the class.

```
package com.example.domain;
```

A Simple Programmer-Created Object Class: Student

- In the example below, a Student class and a Teacher class could be in a folder under the domain name for each developer. If a company called Acme has developers named Smith and Jones, the packages could be:
  - package com.acme.smith
  - package com.acme.jones
- The path for Jones' file is shown below.

Namespace View for Jones:



Folder View for Jones:

```
+com
|_+acme
  |_+jones
    |_+Student.java
    |_+Teacher.java
```

Import Keyword

- The import keyword is used to identify packages or object classes that you want to use in your class.
- You can import a single class or an entire package.
- You can include multiple import statements.
- Import statements follow the package declaration and precede the class declaration.

```
import java.util.Scanner;
```

Import Statements

- An import statement is not required, and by default, your class always imports java.lang from the API.
  - http://docs.oracle.com/javase/7/docs/api/java/lang/Package.html
- You do not need to import classes that are in the same package as the import statement.

Import Statement Examples

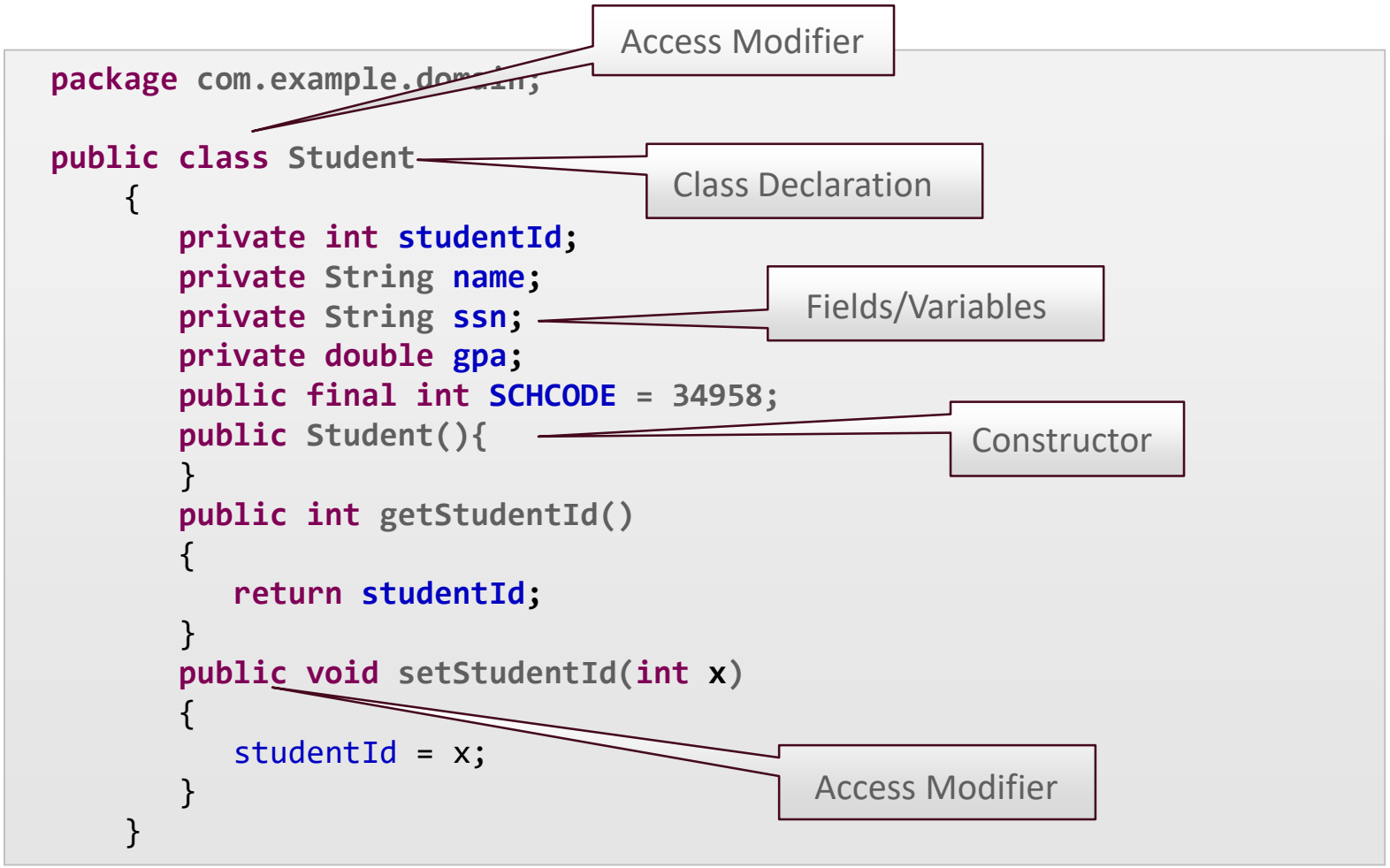
- Additional examples of import statements:

```
import java.util.Date;      // Import the individual class.

import java.util.*;         //Import the entire package.

import java.util.Date;      //Import using multiple statements.
import java.util.Calendar;
```

Variables for Student Class

- In addition to the package statement and import statements, the Student class will contain variables for student Id, name, social security number, grade point average, and school code.
- This will require defining a class with class variables and a constructor.
- In addition, methods will be added that can access and change the variables.

The Student Class



Conventions for the Class Declaration

- Class declaration conventions:
  - The name of the class must be the same as the name of the file that was created in Eclipse.
  - The name must begin with a character, and may contain numbers, _ or $.
  - Use upper camel case if the name is more than one word.
  - For a simple programmer-created object class, the access modifier should be public (all access modifiers are either public, private, or protected).

```
public class Student{}
```

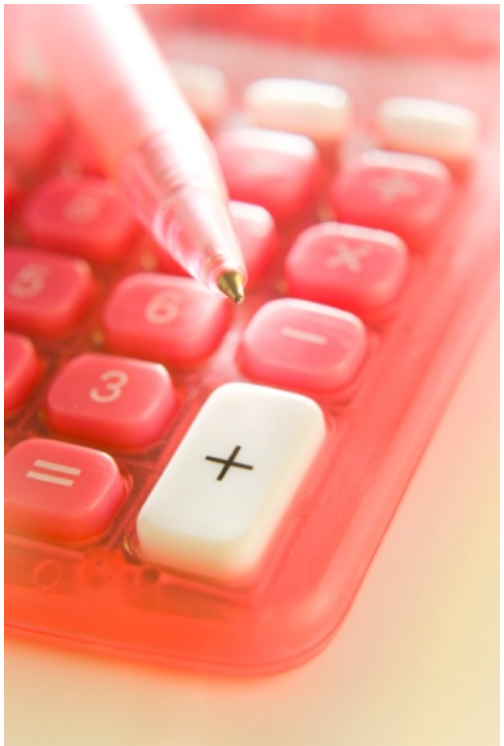
All code for this class must be enclosed in a set of curly brackets { }.

Conventions for the Class Variables

- Class variables conventions:
  - Class variables should be declared with the private access modifier to protect the data.
  - Class variables are named using lower camel case.
  - An exception is a constant (a value that does not change) that should be named using upper case, and declared as public to allow driver programs to access the value.

Class Variable Declaration Examples

- Examples of declaring class variables:
  - private int length;
  - private int width;
  - private double area;
  - public final double SCALE = 0.25; //constant
  - private String name;



Constructor Methods

- A constructor method is unique in Java because:
  - The method creates an instance of the class.
  - Constructors always have the same name as the class and do not declare a return type.

```
public Student()
{

}
```

All code for this method must be enclosed in a set of curly brackets { }.

Constructor Methods

- With constructor methods:
  - You can declare more than one constructor in a class declaration.
  - You do not have to declare a constructor, in fact, Java will provide a default (blank) constructor for you.
  - If you declare one or more constructors, Java will not provide a default constructor.

```
public Student()
{

}
```

All code for this method must be enclosed in a set of curly brackets { }.

Constructors without Parameters

- If you create a constructor without parameters (the parenthesis is empty), you can leave the contents of the constructor (between the { and }) blank.
- This is called a default constructor, and is the same as the Java-provided constructor if you do not declare one.
- This constructor initializes the numeric class variables to zero, and object variables (such as Strings) to null.

```
public Student()
{

}
```

All code for this method must be enclosed in a set of curly brackets { }.

Constructors without Parameters

- If you create a constructor without parameters (the parenthesis is empty), you can also initialize the variables between the { and }. This is also called a default constructor.
- This constructor initializes the numeric class variables to zero, and object variables (such as Strings) to null. It has the same results as the previous slide, but the values are more evident.

```
public Student(){
      studentId = 0;
      name = "";
      ssn = "";
      gpa = 0.0;
}
```

No parameters

Constructors with Parameters

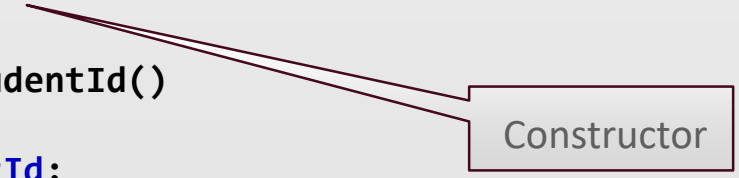
- If you create a constructor with parameters (the parenthesis is NOT empty), you would also initialize the variables between the { and }.
- This constructor will initialize the class variables with the values that are sent in from the main driver class.

```
public Student(int x, String n, String s, double g){
      studentId = x;
      name = n;
      ssn = s;
      gpa = g;
}
```

Default Constructor Example

- The constructor method in this example is a default constructor that creates an instance of Student.

```
package com.example.domain;
public class Student
    {
       private int studentId;
       private String name;
       private String ssn;
       private double gpa;
       public final int SCHCODE = 34958;

       public Student(){
       }

       public int getStudentId()
       {
          return studentId;
       }
    }
```



Default Constructor Example

- The Student example on the previous slide illustrates a simple no-argument constructor.
- The value returned from the constructor is a reference to a Java object of the type created.
- Remember, constructors can also take parameters.

Constructors

- A constructor is a method that creates an object.
- In Java, constructors are methods with the same name as their class used to create an instance of an object.
- Constructors are invoked using the new keyword.
- Example of code that could be used in a Driver Class to create an object from the Student constructor:

```
Student stu = new Student();
```

Main Method

- To run a Java program you must define a main method in a Driver Class.
- The main method is automatically called when the class is called.
- Remember to name the file the same as the class.

A Simple Programmer-Created Driver Class: StudentTester

- For examples in this course, we will often use the name of the object class followed by the word "Tester."
- Below is an example of a simple Java driver class named StudentTester with a main method.

```
public class StudentTester
{
   public static void main(String args[])
   {
   }
}
```

A Simple Programmer-Created Driver Class: StudentTester Example 1

- In this example, a statement is added to create a Student object.
- A Student is created and the class variables are initialized as previously described under default constructors.

```
public class StudentTester
{
   public static void main(String args[])
   {
      Student s1 = new Student();
   }
}
```

A Simple Programmer-Created Driver Class: StudentTester Example 2

- In this example the statement to create an object of the Student class is different.
- This Student is created using parameters.
- Can you guess this student's Id? Name? SSN? GPA?
- Add another student using the default constructor.

```
public class StudentTester
{
   public static void main(String args[]
   {
      Student s1 = new Student(123, "Mary Smith", "999-99-9999", 3.4);
   }
}
```

Enhancing the Student Object Class

- Most modern integrated development environments provide an easy way to automatically generate the accessor (getter) and mutator (setter) methods.
- Another method that helpful during testing, creating and modifying objects is the toString() method.
- In the next few slides, we will develop new methods for the Student object class and modify the StudentTester driver class to test them.

Accessor and Mutator Methods

- It is common to create a set of methods that manipulate and retrieve class data values:
- Accessors (getters): Methods that return (get) the value of each class variable.
- Mutators (setters): Methods that change (set) the value of each class variable.

Accessor and Mutator Methods to Enhance the Student Object Class

- Examples (to follow):
  - Add the following Accessor methods:
    - getStudentId(), getName(), getSSN(), getGPA()
  - Add the following Mutator methods:
    - setStudentId(), setName(), setSSN(), setGPA()
  - Add a toString() method to the Student class that will allow us to see the Student data as output.

Enhancing the Student Object Class

- Add the getStudentId() method and the setStudentId() method as shown below.
- The object name of the class (this) is used to distinguish between the class variable studentId and the parameter studentId being passed in as an argument.

```
public int getStudentId()
      {
         return studentId;
      }
public void setStudentId(int studentId)
      {
         this.studentId = studentId;
      }
```

Additional Methods for the Student Object Class

- Now using the example from the previous slide, add the following methods to the Student object class:
  - getName(), getSSN(), getGPA()
  - setName(), setSSN(), setGPA()

Add the toString() Method to the Student Object Class

- Now add the toString() method to the Student object class.
- Note, any String object can be built by you to display the information about each student:

```
public String toString()
       {
          String s1 = "";
          s1 =  "Student Id: " + getStudentId() +
                   "Student Name: " + getName() +
                   "Student SSN: " + getSSN() +
                   "Student GPA: " + getGPA();
          return s1;
       }
```

Creating the StudentTester Driver Class Main Method

- Now create a StudentTester Driver Class main Method as follows:

```
public class StudentTester
{
   public static void main(String args[]
   {
      Student s1 = new Student(123, "Mary Smith", "999-99-9999", 3.4);
      System.out.println(s1);
      Student s2 = new Student();
      s2.setStudentId(124);
      s2.setStudentName("John Jacoby");
      s2.setSSN("123-45-6789");
      s2.setGPA(4.0);
      System.out.println(s2);
      Student s3 = new Student();
      System.out.println(s3);
   }
}
```

Code Blocks

- A code block is defined by opening and closing "curly braces" { }. When examining code blocks, consider the following:
  - Every class declaration is enclosed in a code block.
  - Method declarations, including the main method, are enclosed in code blocks.
  - Java fields and methods have block (or class) scope.

```
public class SayHello
{                                                   // Begin class code block

   public static void main(String args[]
   {                                                // Begin method code block
       System.out.println("Hello Lisa");
   }                                                // End method code block
}                                                   // End class code block
```

Code Block Format

- Code blocks begin with a { and end with a }.
- Each time you begin a code block you must have an end.
- For example: Every { MUST have a matching }.
- Code blocks can be found in:
  - Classes
  - Methods
  - Conditionals (if statements, switch statements)
  - Loops

Terminology

Key terms used in this lesson included:

- Access modifiers
- Code blocks
- Constants
- Constructors
- Driver class

Terminology

Key terms used in this lesson included:

- import statements
- Java API
- Java comments
- Java keywords
- Lower camel case
- Methods

Terminology

Key terms used in this lesson included:

- Object class
- Packages
- Parameters
- Programmer-created class
- Upper camel case
- Variables

Summary

In this lesson, you should have learned how to:

- Describe the general form of a Java program
- Describe the difference between an Object class and a Driver class
- Access a minimum of two Java class APIs
- Explain and give examples of Java keywords
- Create an Object class
- Create a Driver class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