Creating Your Own Classes

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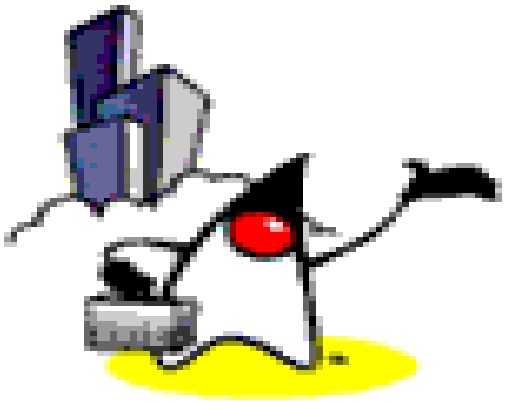
Objectives

At the end of the lesson, the students should be able to:

- Create their own classes
- Declare properties (fields) and methods for their classes
- Use the this reference to access instance data
- Create and call overloaded methods
- Use access modifiers to control access to class members



Defining Your Own Class

Defining your own classes

- Things to take note of for the syntax defined in this section:

*	0 or more occurrences of the line where it was applied to.
<description>	substitute an actual value for this part instead of typing it as it is.
[ ]	this part is optional

Defining your own classes

- To define a class, we write:

```
<modifier> class <name> {
        <attributeDeclaration>*
        <constructorDeclaration>*
        <methodDeclaration>*
}
```

  - where
    - <modifier> is an access modifier, which may be combined with other types of modifier.

Example: Define StudentRecord Class

```
public class StudentRecord {
    //we'll add more code here later
}
```

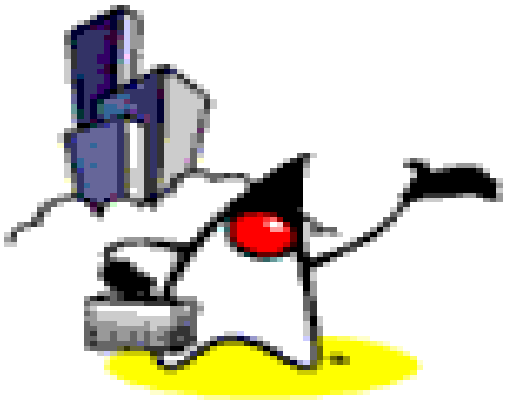
- where,
  - public - means that our class is accessible to other classes outside the package
  - class - this is the keyword used to create a class in Java
  - StudentRecord - a unique identifier that describes our class

Coding Guidelines

- Think of an appropriate name for your class. Don't just call your class XYZ or any random names you can think of.
- Class names starts with a CAPITAL letter - not a requirement, however.
- The file name of your class must have the SAME NAME as your class name.
  - StudentRecord class should be defined in StudentRecord.java

Demo:

Exercise 1: Create your class
1014_javase_createclass.zip



Instance Variables vs. Static Variables

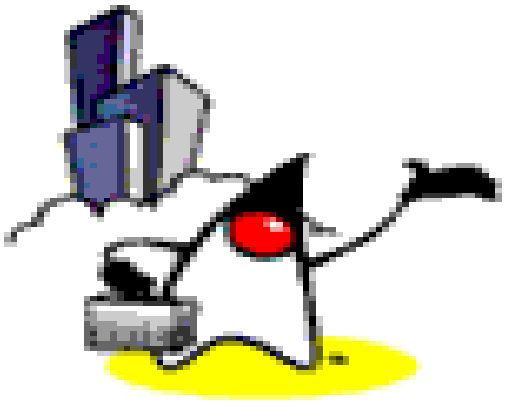
Instance Variables (Properties) vs. Class (Static) Variables

- Instance Variables
  - Belongs to an object instance
  - Value of variable of an object instance is different from the ones of other object object instances from the same class
- Class Variables (also called static variables)
  - Variables that belong to the class.
  - This means that they have the same value for all the object instances in the same class.

Class Variables

- For example,

Car Class		Object Car A	Object Car B
Instance Variables	Plate Number	ABC 111	XYZ 123
	Color	Blue	Red
	Manufacturer	Mitsubishi	Toyota
	Current Speed	50 km/h	100 km/h
Class Variable	Count = 2		
Instance Methods	Accelerate Method		
	Turn Method		
	Brake Method		



Instance Variables

Declaring Properties (Attributes)

- To declare a certain attribute for our class, we write,

```
<modifier> <type> <name> [=
  <default_value>];
```

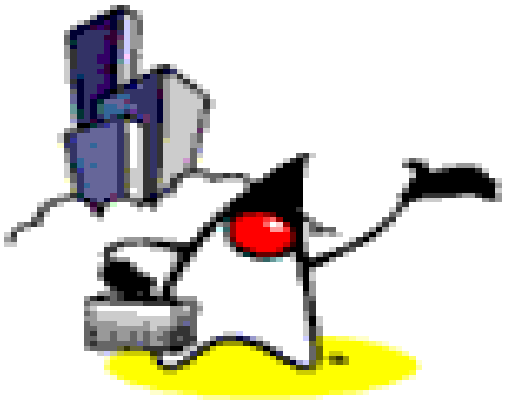
Instance Variables

```
public class StudentRecord {
    // Instance variables
     private String    name;
     private String    address;
     private int    age;
     private double mathGrade;
     private double englishGrade;
     private double scienceGrade;
     private double average;
     //we'll add more code here later
}
```

- where,
  - private here means that the variables are only accessible within the class. Objects of other classes cannot access these variables directly. We will cover more about accessibility later.

Coding Guidelines for Instance Variables

- Declare all your instance variables right after “public class Myclass {“
- Declare one variable for each line.
- Instance variables, like any other variables should start with a small letter.
- Use an appropriate data type for each variable you declare. (mandatory)
- Declare instance variables as private so that only methods in the same class can access them directly.
  - Encapsulation

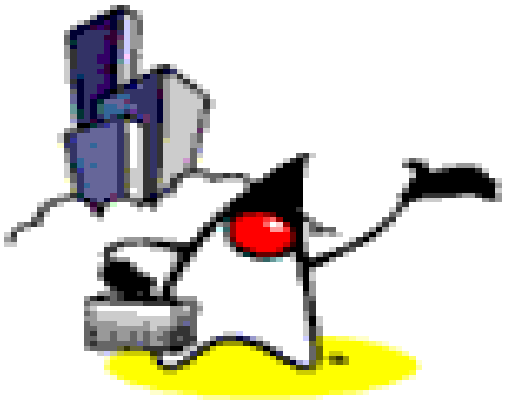


Static Variables

Static (Class) variables

```
public class StudentRecord {
    // static variables
    private static int studentCount;
    // we'll add more code here later
}
```

- we use the keyword static to indicate that a variable is a static (class) variable.



Methods

Declaring Methods

- To declare methods we write,

```
<modifier> <returnType>
  <name>(<parameter>*) {
        <statement>*
}
```

  - where,
    - <modifier> can carry a number of different modifiers
    - <returnType> can be any data type (including void)
    - <name> can be any valid identifier
    - <parameter> ::= <parameter_type> <parameter_name>[,]

Accessor (Getter) Methods

- Accessor methods
  - used to get (retrieve) data (in the form of object or primitive) from our class variables (instance/static).
  - usually written as:

```
get<NameOfInstanceVariable>
```

Example 1: Accessor (Getter) Method

```
public class StudentRecord {
    private String  name;
    :
    public String getName(){
       return name;
    }
}
```

- where,
  - public - means that the method can be called from objects of other classes
  - String - is the return type of the method. This means that the method should return an object of type String
  - getName - the name of the method
  - () - this means that our method does not have any parameters

Example 2: Accessor (Getter) Method

```
public class StudentRecord {
    private String  name;
    // some code

    // An example in which the business logic is
    // used to return a value on an accessor method
    public double getAverage(){
        double result = 0;
        result=(mathGrade+englishGrade+scienceGrade)/3;
        return result;
    }
}
```

Mutator (Setter) Methods

- Mutator Methods
  - used to write or change values of a variable
  - Usually written as:

```
set<NameOfInstanceVariable>
```

Example: Mutator (Setter) Method

```
public class StudentRecord {
    private String  name;
    :
    public void setName( String temp ){
       name = temp;
    }
}
```

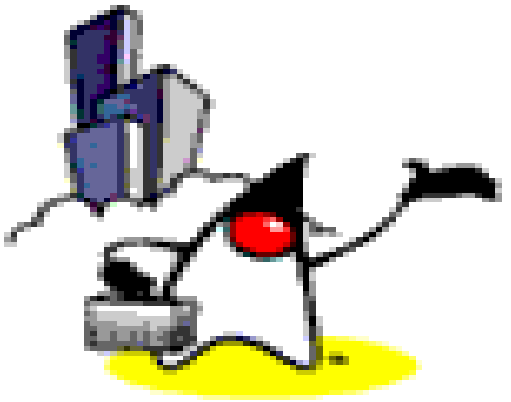
- where,
  - public - means that the method can be called from objects of other classes
  - void - means that the method does not return any value
  - setName - the name of the method
  - (String temp) - parameter that will be used inside our method

Multiple return statements

- You can have multiple return statements for a method as long as they are not on the same block

Example: Multiple return statements

```
public String getNumberInWords( int num ){
    String defaultNum = "zero";
    if( num == 1 ){
       return "one";
    }
    else if( num == 2){
       return "two";
    }
    return defaultNum;
}
```



Static Methods

Static methods

```
public class StudentRecord {
    private static int studentCount;
    public static int getStudentCount(){
       return studentCount;
    }
}
```

- where,
  - public- means that the method can be called from objects of other classes
  - static-means that the method is static and should be called by typing,[ClassName].[methodName]. For example, in this case, we call the method `StudentRecord.getStudentCount()`
  - int- is the return type of the method. This means that the method should return a value of type int
  - getStudentCount- the name of the method
  - ()- this means that our method does not have any parameters

Coding Guidelines for Methods

- Method names should start with a small letter.
- Method names should sound like a verb
- Provide documentation before the declaration of the method. You can use Javadocs style for this.

When to Define Static Method?

- When the logic and state does not involve object instances (different property values of different object instances do not play a role in the logic)
  - Computation method
  - add(int x, int y) method
- When the logic is a convenience without creating an object instance
  - Integer.parseInt();

Source Code for StudentRecord class

```
public class StudentRecord {

    // Instance variables
     private String    name;
     private String    address;
     private int    age;
     private double mathGrade;
     private double englishGrade;
     private double scienceGrade;
     private double average;
     private static int studentCount;
```

Source Code for StudentRecord Class

```
/**
 * Returns the name of the student (Accessor method)
 */
public String getName(){
    return name;
}

/**
 * Changes the name of the student (Mutator method)
 */
public void setName( String temp ){
    name = temp;
}
```

Source Code for StudentRecord Class

```
/**
 * Computes the average of the english, math and science
 * grades (Accessor method)
 */
public double getAverage(){
    double result = 0;
    result = ( mathGrade+englishGrade+scienceGrade )/3;
    return result;
}
/**
 * returns the number of instances of StudentRecords
 * (Accessor method)
 */
public static int getStudentCount(){
    return studentCount;
}
```

Sample Source Code that uses StudentRecord Class

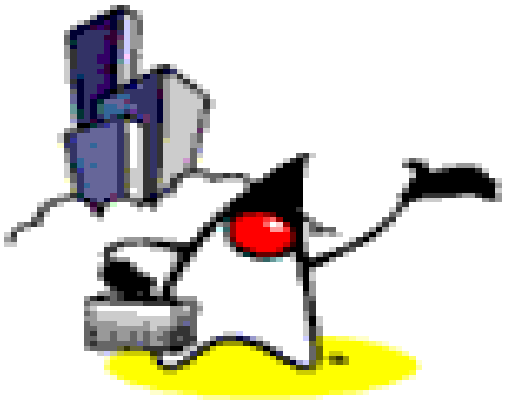
```
public class StudentRecordExample
{
   public static void main( String[] args ){

    //create three objects for Student record
    StudentRecord   annaRecord = new StudentRecord();
    StudentRecord   beahRecord = new StudentRecord();
    StudentRecord   crisRecord = new StudentRecord();

    //set the name of the students
    annaRecord.setName("Anna");
    beahRecord.setName("Beah");
    crisRecord.setName("Cris");

    //print anna's name
    System.out.println( annaRecord.getName() );

    //print number of students
    System.out.println("Count="+StudentRecord.getStudentCount());
   }
}
```

Program Output

```
Anna
Student Count = 0
```

Demo:

Exercise 2: Static/Instance variables & Static/Instance methods
1014_javase_createclass.zip



Overloading Methods

Method Overloading

- Method overloading
  - allows a method with the same name but different parameters, to have different implementations and return values of different types
  - can be used when the same operation has different implementations.
- Always remember that overloaded methods have the following properties:
  - the same method name
  - different number of parameters or different types of parameters
  - return types can be different or the same

Method Overloading Example

```
public void print( String temp ){
    System.out.println("Name:" + name);
    System.out.println("Address:" + address);
    System.out.println("Age:" + age);
}

public void print(double eGrade, double mGrade,
                  double sGrade)
    System.out.println("Name:" + name);
    System.out.println("Math Grade:" + mGrade);
    System.out.println("English Grade:" + eGrade);
    System.out.println("Science Grade:" + sGrade);
}
```

Example

```
public static void main( String[] args )
{
    StudentRecord  annaRecord = new StudentRecord();

    annaRecord.setName("Anna");
    annaRecord.setAddress("Philippines");
    annaRecord.setAge(15);
    annaRecord.setMathGrade(80);
    annaRecord.setEnglishGrade(95.5);
    annaRecord.setScienceGrade(100);

    //overloaded methods
    annaRecord.print( annaRecord.getName() );
    annaRecord.print( annaRecord.getEnglishGrade(),
             annaRecord.getMathGrade(),
                annaRecord.getScienceGrade());
}
```

Output

- we will have the output for the first call to print,

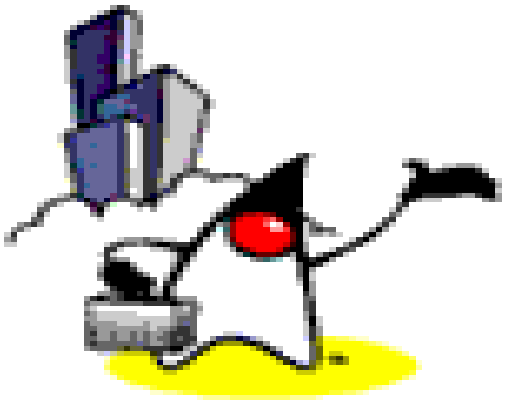
```
Name:Anna
Address:Philippines
Age:15
```

- we will have the output for the second call to print,

```
Name:Anna
Math Grade:80.0
English Grade:95.5
Science Grade:100.0
```

Demo:

Exercise 3: Overloading Methods
1014_javase_createclass.zip



Constructors (Constructor Methods)

Constructors

- Constructors are important in instantiating an object. It is a method where all the initializations are placed.

- The following are the properties of a constructor:
  - Constructors have the same name as the class
  - A constructor is just like an ordinary method with some differences
  - Constructors does not have any return value
  - You cannot call a constructor directly, it gets called indirectly when object gets instantiated

Constructors

- To declare a constructor, we write,

```
<modifier> <className> (<parameter>*) {
        <statement>*
}
```

Default Constructor (Method)

- The **default constructor (no-arg constructor)**
  - is the constructor without any parameters.
  - If the class does not specify any constructors, then an default constructor gets created automatically

Example: Default Constructor Method of StudentRecord Class

```
// Default constructor of StudentRecord class
public StudentRecord(){
    //some code here
}
```

Overloading Constructor Methods

```
public StudentRecord(){
    //some initialization code here
}
public StudentRecord(String temp){
    this.name = temp;
}
public StudentRecord(String name, String address){
    this.name = name;
    this.address = address;
}
public StudentRecord(double mGrade, double eGrade,
                     double sGrade){
    mathGrade = mGrade;
    englishGrade = eGrade;
    scienceGrade = sGrade;
}
```

Example: Using Constructors

```
public static void main( String[] args ){
    //create three objects for Student record
    StudentRecord  annaRecord=
                     new StudentRecord("Anna");
    StudentRecord  beahRecord=
                     new StudentRecord("Beah",
                                       "Philippines");
    StudentRecord  crisRecord=
                     new StudentRecord(80,90,100);
    //some code here
}
```

“this()” constructor call

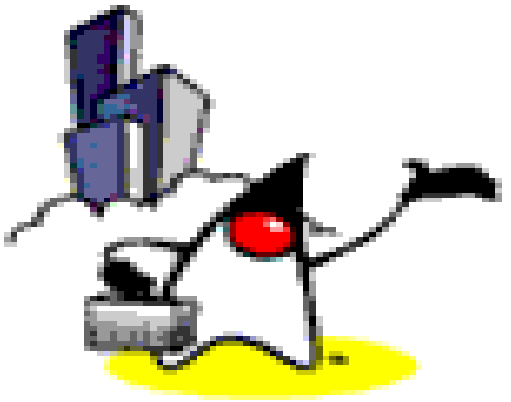
- Constructor calls can be chained, meaning, you can call another constructor from inside another constructor.
- We use the this() call for this
- There are a few things to remember when using the this() constructor call:
  - When using the this constructor call, IT MUST OCCUR AS THE FIRST STATEMENT in a constructor
  - It can ONLY BE USED IN A CONSTRUCTOR DEFINITION. The this call can then be followed by any other relevant statements.

Example

```
1: public StudentRecord(){
2:     this("some string");
3:
4: }
5:
6: public StudentRecord(String temp){
7:     this.name = temp;
8: }
9:
10: public static void main( String[] args )
11: {
12:
13:     StudentRecord    annaRecord = new StudentRecord();
14: }
```

Demo:

Exercise 4: Constructor
1014_javase_createclass.zip



“this” Reference

“this” reference

- The this reference
  - refers to current object instance itself
  - used to access the instance variables

- To use the this reference, we type,

```
this.<nameOfTheInstanceVariable>
```

- You can only use the this reference for instance variables and NOT static or class variables
  - Because this refers to an object instance

“this” reference

- The this reference is assumed when you call a method from the same object

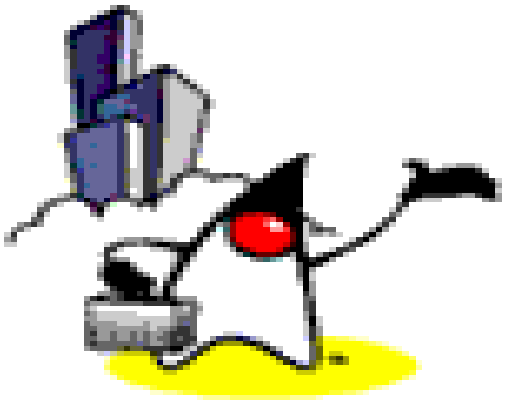
```
public class MyClass {
    void aMethod() {
        // same thing as this.anotherMethod()
        anotherMethod();
    }
    void anotherMethod() {
      // method definition here...
    }
}
```

Example

```
public void setAge( int age ){
    this.age = age;
}
```

Demo:

Exercise 5: “this”
1014_javase_createclass.zip



Access Modifiers

Access Modifiers

- There are four different types of member access modifiers in Java:
  - public (Least restrictive)
  - protected
  - default
  - private (Most restrictive)
- The three access modifiers in blue color are explicitly written in the code to indicate the access type, for the 3rd one (“default”), no keyword is used.

public accessibility

- public access
  - specifies that class members (variables or methods) are accessible to anyone, both inside and outside the class and outside of the package to which the class belongs
  - Any object that interacts with the class can have access to the public members of the class.
  - Keyword: public

Example: “public” Access Modifer

```
public class StudentRecord {
    // public access to instance variable
    public int name;

    // public access to method
    public String getName(){
       return name;
    }
}
```

protected accessibility

- protected access
  - Specifies that the class members are accessible only to methods in that class and the subclasses of the class.
  - The subclass can be in different packages
  - Keyword: protected

Example: “protected” Access Modifier

```
public class StudentRecord {
    //protected access to instance variable
    protected String name;

    //protected access to method
    protected String getName(){
       return name;
    }
}
```

default accessibility

- Default access
  - specifies that only classes in the same package can have access to the class' variables and methods
  - no actual keyword for the default modifier; it is applied in the absence of an access modifier.

Example

```
public class StudentRecord {
    //default access to instance variable
    int  name;

    //default access to method
    String getName(){
       return name;
    }
}
```

private accessibility

- private accessibility
  - specifies that the class members are only accessible within the class
  - Keyword: private

Example: “private” Access Modifier

```
public class StudentRecord {
    //private access to instance variable
    private int   name;

    //private access to method
    private String getName(){
       return name;
    }
}
```

Java Program Structure: The Access Modifiers

	private	default/package	*protected*	*public*
Same class	Yes	Yes	Yes	Yes
Same package		Yes	Yes	Yes
Different package (subclass)			Yes	Yes
Different package (non-subclass)				Yes

Coding Guidelines

- The instance variables of a class should normally be declared private, and the class will just provide accessor and mutator methods to these variables.

Demo:

Exercise 6: Access Modifiers
1014_javase_createclass.zip

Summary

- Defining your own classes
- Declaring Fields (instance, static/class)
- Declaring Methods (accessor, mutator, static)
- Returning values and Multiple return statements
- The this reference
- Method overloading
- Constructors (default, overloading, this() call)
- Packages
- Access Modifiers (default, public, private, protected)

Thank you!

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