ATC
Advanced Training Consultants

Java Fundamentals for Android Development

Version B

By: Android ATC Team

- Java Fundamentals topics.
- Lessons target beginners and allows a smooth start with Android programming.
- Practical lessons and instructions accompanied by relevant snapshots.

Java Fundamentals for Android™ Development

version B

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Android ATC Team.

Table of Contents

Introduction

Since the Android software development kit (Android SDK) is built in Java programming language, this book serves as a mini-course made up of three lessons on the fundamentals of Java programming.

The course will teach you the basics of Java programming language and object oriented programming (OOP) concepts required for the development of Android applications.

If you are already an experienced Java programmer who wants to learn development of Android applications, you can skip reading this book and move directly to reading the book titled "Android Application Development" – a companion to the Android application development course. For everyone else, reading the book and practicing its exercises is a must. It will simply prepare you for Android development.

Intended Audience

This book is for anyone interested in learning the basics of Java programming language, but ultimately looking for learning Android application development. All professionals seeking a certification in any Android-related course provided by Android ATC, should thoroughly understand the contents of this Java crash course.

Although there is no specific Android ATC exam tied to this course, taking any other Android programming course (like AND-401) requires sufficient knowledge the contents of this course.

Lesson 1: Java Basics

Introduction

Java programming language

Java Virtual Machine

JDK and JRE

Setting up your machine for Java programming

Hello World in Java

Using a text Editor

Using an IDE

Java Primitive Data Type

Naming

Arrays

Control Flow

If/Else and Switch

Switch statement

While loop

For Loop

Lab 1

Lesson 1: Java Basics

Introduction

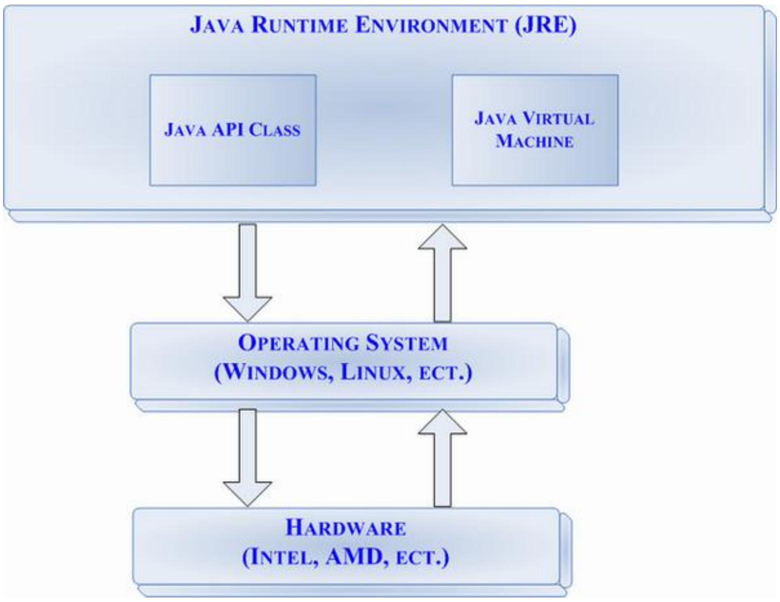
This lesson introduces the Java programming language. It starts with the basic syntax of the language, and ends with a guide on setting up your machine for Java and Android programming.

Java Programming Language

Java programming language was originally developed at Sun Microsystems and released in 1995. Java applications are typically compiled to byte code (class file) that can run on any Java virtual machine (JVM) regardless of the operating system running on it. Java is a general-purpose, object-oriented language. It was designed to let developers "write once, run anywhere" (WORA), meaning that code that runs on one platform does not need to be recompiled to run on another. Java is, one of the most popular programming languages in use.

Java Virtual Machine

The Java virtual machine (JVM) is the component of Java framework that executes the compiled Java code. When a developer compiles a Java file successfully, the Java compiler produces a *bytecode file* and has a .class extension. A Java byte code is an intermediate language produced by a Java compiler and only executed on a JVM.


Java Runtime Environment (JRE)
Java API Class
Java Virtual Machine
Operating System (Windows, Linux, ect.)
Hardware (Intel, AMD, ect.)

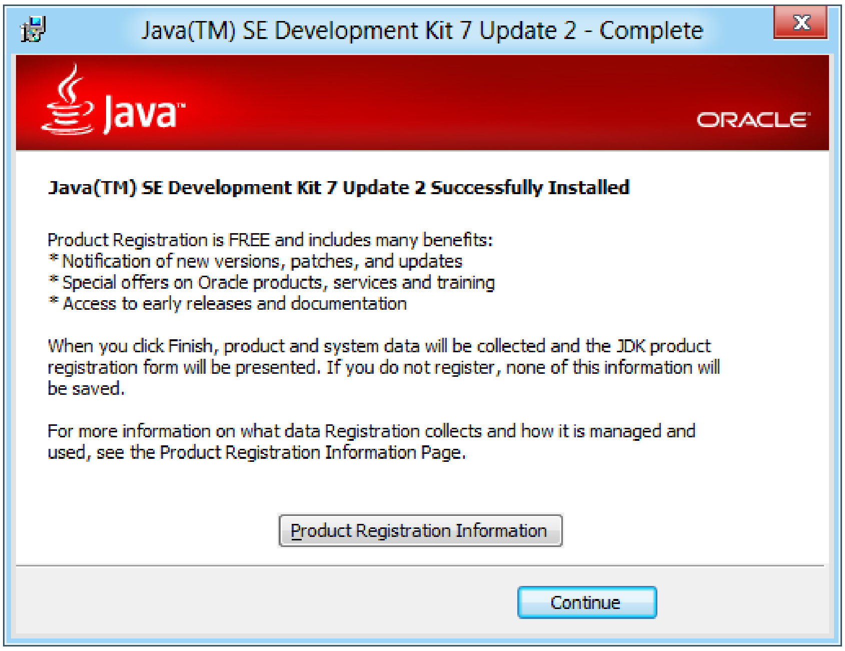
JDK and JRE

To be able to start programming in Java, a developer needs to main components: Java development kit and Java Runtime environment. The development kit (JDK) provides a Java compiler in addition to other tools. These tools allow a programmer to write Java code and convert it to a bytecode file to be executed by a JVM. The program that compiles Java code is *javac*. The Java Runtime environment is the execution environment for Java programs. These programs are compiled into a portable binary format (.class files) by the compiler – a program called *java*.

If you install on your machine the JRE, then your system can run Java programs. To start writing Java programs you need to setup JDK as well.

Setting up your machine for Java programming

To Start Java Programming, you should install the Java development kit on your machine. You can do so by downloading it from Java SE downloads webpage on Oracle.com – the owner of Java. Make sure to download the correct version compatible to your machine (32bit or 64bit installer). After downloading the installer and setting up your machine, you'll get the following message:



Java(TM) SE Development Kit 7 Update 2 Successfully Installed

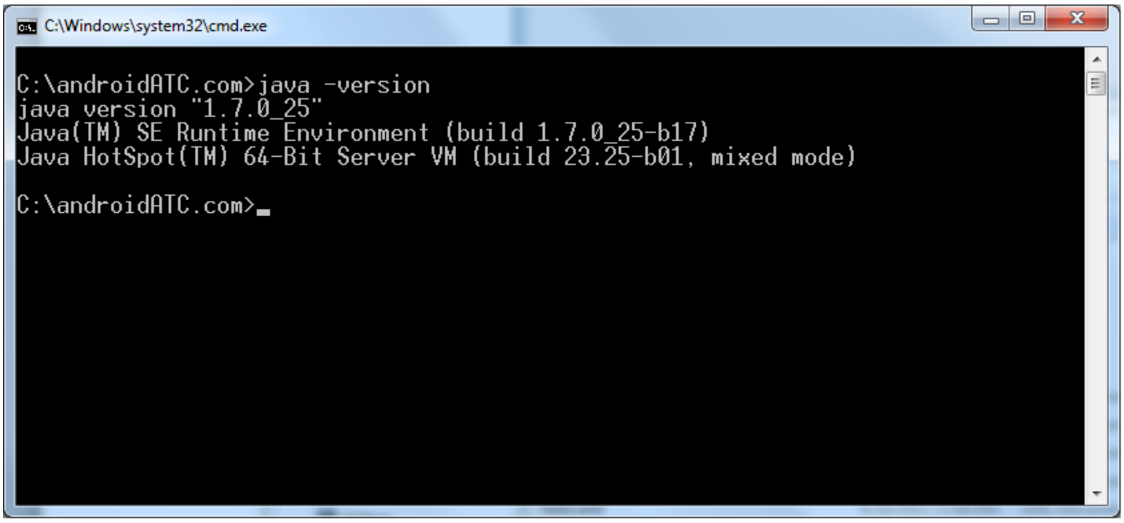
Product Registration is FREE and includes many benefits:
* Notification of new versions, patches, and updates
* Special offers on Oracle products, services and training
* Access to early releases and documentation

When you click Finish, product and system data will be collected and the JDK product registration form will be presented. If you do not register, none of this information will be saved.

For more information on what data Registration collects and how it is managed and used, see the Product Registration Information Page.

To verify you have successfully installed JDK on your machine, do the following:

1. Open a command prompt by clicking start →run, then typing **cmd**
2. In the windows that opens, type **java –version.**
3. You should information similar to the following:



```
C:\androidATC.com>java -version
java version "1.7.0_25"
Java(TM) SE Runtime Environment (build 1.7.0_25-b17)
Java HotSpot(TM) 64-Bit Server VM (build 23.25-b01, mixed mode)

C:\androidATC.com>_
```

Hello World in Java

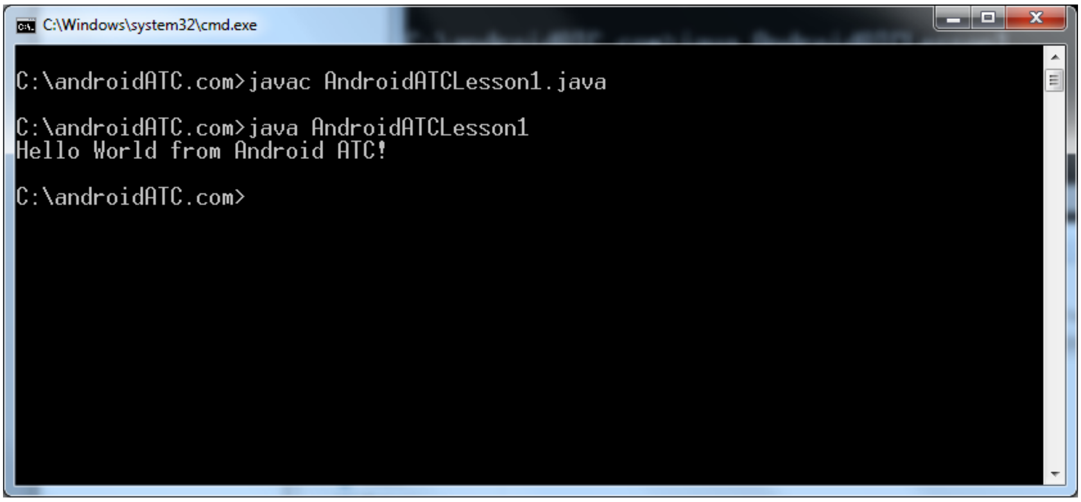
We will see in this section how to write a hello-world program in Java using a plain text editor (like Notepad) or an integrated development environment (like Eclipse).

Using a text Editor

1. Open a simple text editor (like Notepad), and type the following Java code:

```
public class AndroidATCLesson1 {

	public static void main(String[] args) {
		System.out.println("Hello World from Android ATC!");
	}

}
```

2. Save the file as Lesson1.java under the path **c:\**.
   Notice that the file name is the same as the class name in the code.
3. Open a command prompt and compile the code by typing **javac AndroidATCLesson1.java**
4. If you don’t see any error displayed by the compiler, it means the compile is successful and you can run the program. To run it type **java AndroidATCLesson1**
5. The line **“Hello World from Android ATC!”** should be printed.



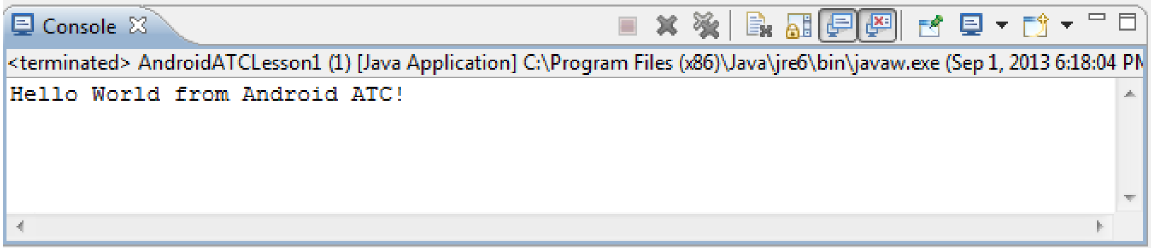
```
C:\androidATC.com>javac AndroidATCLesson1.java

C:\androidATC.com>java AndroidATCLesson1
Hello World from Android ATC!

C:\androidATC.com>
```

Once you compile a Java file successfully, another file of extension .class is created. This is the byte code file that is executed by JVM.

Using an IDE

An integrated development environment (IDE) is an application that provides a set of tools to help a developer accomplish many tasks more efficiently. The following steps describe how to create, compile and run the simple Hello-World Java program using the Eclipse IDE.

1. Create and Eclipse project which will contain Java file. Click on File →New →Java Project.
2. Enter project name then click Finish.
3. On the left pane, under Package Explorer, expand the project then right click on **src.**
4. Move cursor to New, then click on Class
5. In Name field, enter the class name: *Lesson1.java* then click finish
6. In the file editor, the file Lesson1.java will open. Type in the same code as the previous section.
7. Click on the Run button.
8. The “Hello World!” should display in the Console view.



```
<terminated> AndroidATCLesson1 (1) [Java Application] C:\Program Files (x86)\Java\jre6\bin\javaw.exe (Sep 1, 2013 6:18:04 PM
Hello World from Android ATC!
```

Java Primitive Data Type

All variables in Java must be declared before they can be used. This is done by specifying the type of the variable and the variable's name:

int someVar = 1;

Java supports eight different primitive data types:

1. **byte**: The byte data type is an 8-bit signed integer.
2. **short**: The short data type is a 16-bit signed integer.
3. **int**: The int data type is a 32-bit signed integer. It has a maximum value of 2,147,483,647.
4. **long**: The long data type is a 64-bit signed integer.
5. **float**: The float data type is a single-precision 32-bit floating point.
6. **double**: The double data type is a double-precision 64-bit floating point.
7. **boolean**: The boolean data type has only two possible values: true and false.
8. **char**: The char data type is a single 16-bit Unicode character.

Naming

Java has the following rules and conventions for naming variables:

- Variable names are case-sensitive
- Beginning with a letter, the dollar sign "$", or the underscore character "_" is allowed
- Subsequent characters may be letters, digits, dollar signs, or underscore characters.
- By convention, you should name your variables using "camel case", i.e. if the name consists of only one word, it is all lowercase letters. If it consists of more than one word, the first letter of each subsequent word is capitalized.
- Also by convention, constants are all capitalized and contain underscore.

Arrays

Arrays are containers that hold a fixed number of values of a certain type. The length of an array is fixed and is declared when the array is created.

To declare and array of ten integer elements:

```
int[] myArray = new int[10];
```

Each item in an array is called an element, and each element is accessed by its numerical index. Index numbering in arrays begins with 0. The 10th element, for example, is therefore accessed by index number 9. You can assign a value to an array element using the following syntax:

The following program, Lesson1Array, creates an array of integers, puts some values in it, and prints each value to standard output.

```
class Lesson1Array {
      public static void main(String[] args) {
            // Allocate memory for 5 integers
            int[] anArray;
            anArray = new int[5];

            // Initialize elements
            anArray[0] = 10;
            anArray[1] = 20;
            anArray[2] = 30;
            anArray[3] = 40;
            anArray[4] = 50;

            System.out.println("Value at index 0: " + anArray[0]);
            System.out.println("Value at index 1: " + anArray[1]);
            System.out.println("Value at index 2: " + anArray[2]);
            System.out.println("Value at index 3: " + anArray[3]);
            System.out.println("Value at index 4: " + anArray[4]);
      }
}
```

Control Flow

Statements in Java code are executed sequentially - from top to bottom- in the order that they appear. However, a programmer can *control the flow of execution* using conditional statement, loops, and branches. This section describes the usage of decision-making statements (`if/else` and `switch`), loops(`for`, `while`), and the branching statements (`break`,`continue`, `return`) .

If/Else and Switch

If/else statements tell your program to execute a certain section of code only if a particular condition is `true`.

```
if (someExpression)
    statement1
else
   statement2
```

If *someExpression* evaluates to **true**, then *statement1* is executed. If someExpression evaluates to false, then statement2 is executed.

Switch statement

Unlike if/else statements, the switch statement can have a number of possible execution paths. A switch works with the *byte, short, char, and int* primitive data types.

The following is an example of switch statement that prints outputs based on the age variable:

```
int dayOfWeek = 1;
String dayString="";
switch (dayOfWeek) {
        case 1:  dayString = "Monday";
                break;
        case 2:  dayString = "Tuesday";
                break;
        case 3:  dayString = "Wednesday";
                break;
        case 4:  dayString = "Thursday";
                break;
        case 5:  dayString = "Friday";
                break;
        case 6:  dayString = "Saturday";
                break;
        case 7:  dayString = "Sunday";
                break;
        }
System.out.println(dayString);
```

While loop

A `while` loop statement continually executes a block of code while a particular condition is `true`. Its syntax can be expressed as:

```
while (expression) {
     statement(s)
}
```

Expression is a statement that must evaluate to a Boolean value (either true or false). If it evaluates to true then the following block will execute repeatedly until expression becomes false.

The following code snippet will print out the value of variable counter 10 times until it become equal to 11:

```
int counter = 1;
while (counter < 11) {
    System.out.println("Count is: " + counter);
    counter++;
}
```

For Loop

The `for` statement provides a compact way to iterate over a range of values. Programmers often refer to it as the "for loop" because of the way in which it repeatedly loops until a particular condition is satisfied. The general form of the `for` statement can be expressed as follows:

```
for (initialization; termination-condition; increment) {
    statement(s)
}
```

The following code uses the general form of the `for` statement to print the numbers 1 through 10 to standard output:

```
for (int i = 1; i <= 10; i++) {

      System.out.println("Value of i is: " + i);

}
```

Lab 1

Objectives

- Create a new Java project under Eclipse
- Practice control statements in Java

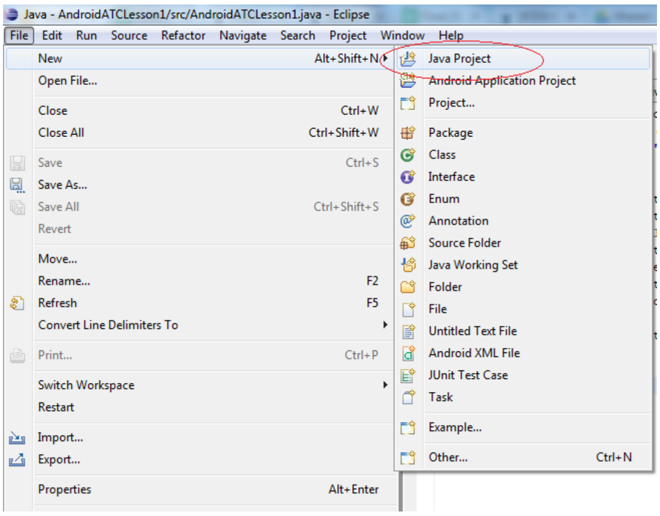
Pre-requisites

You need to create a new Java project under Eclipse before solving these exercises. Follow the steps in the section below.

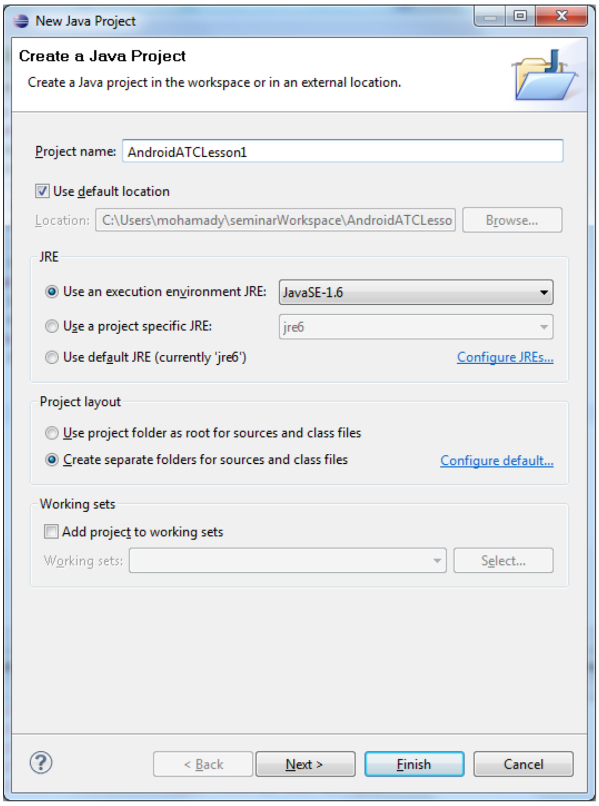
Creating a Java project

Create a Java project under Eclipse following these steps

1. Open Eclipse IDE.
2. On the **File** menu, point to **New**, and then choose **Java Project**.



3. In the **New Java Project** Dialog, enter AndroidATCLesson1 in Project name field.


New Java Project

Create a Java Project

Create a Java project in the workspace or in an external location.

Project name: AndroidATCLesson1

☑ Use default location

Location: C:\Users\mohamady\seminarWorkspace\AndroidATCLesso

JRE

● Use an execution environment JRE: JavaSE-1.6

○ Use a project specific JRE: jre6

○ Use default JRE (currently 'jre6')

Project layout

○ Use project folder as root for sources and class files

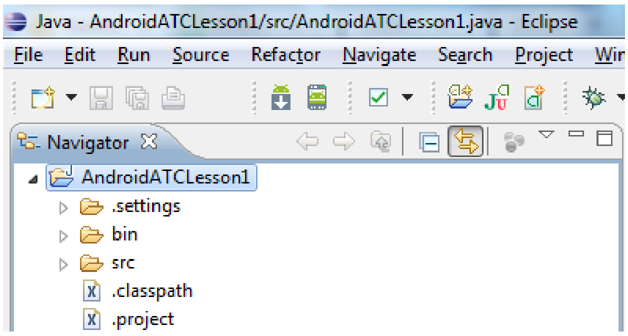
● Create separate folders for sources and class files

Working sets

☐ Add project to working sets

Working sets:

4. Click on **Finish**, keeping all values as default.



Now you will have a new empty Java project created.

Exercise

Write the Java code that prints numbers from 1 to 10, each on a separate line.

In this exercise, you will create a new Java project under Eclipse and write required code then run the program.

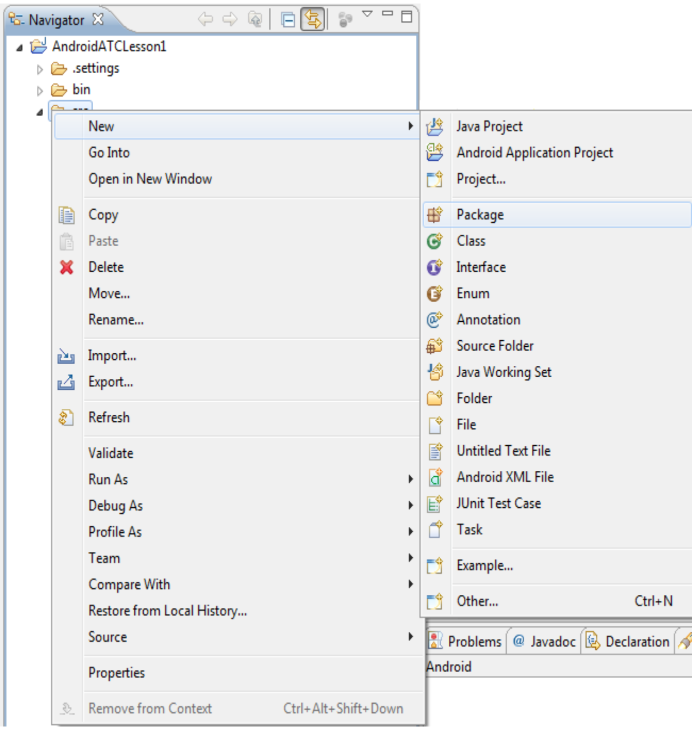
➢ Create a Java project under Eclipse

Follow the steps from 1 to 4 in section “Creating a Java project” above.

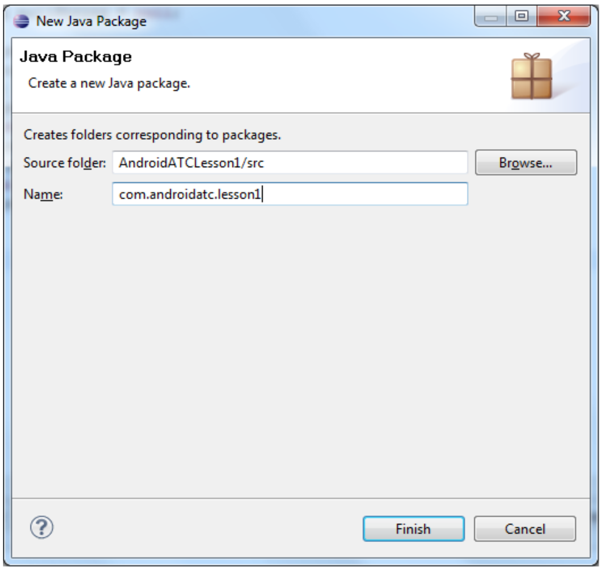
➢ Create a Java package

a. In the Navigator view to the left of you Eclipse editor, right click on folder src

b. In menu that shows up, point to New, and then choose Package.



c. **In the “New Java Package” dialog, type in the field Name the following:** ***com.androidatc.lesson1***



New Java Package

Java Package

Create a new Java package.

Creates folders corresponding to packages.

Source folder: AndroidATCLesson1/src

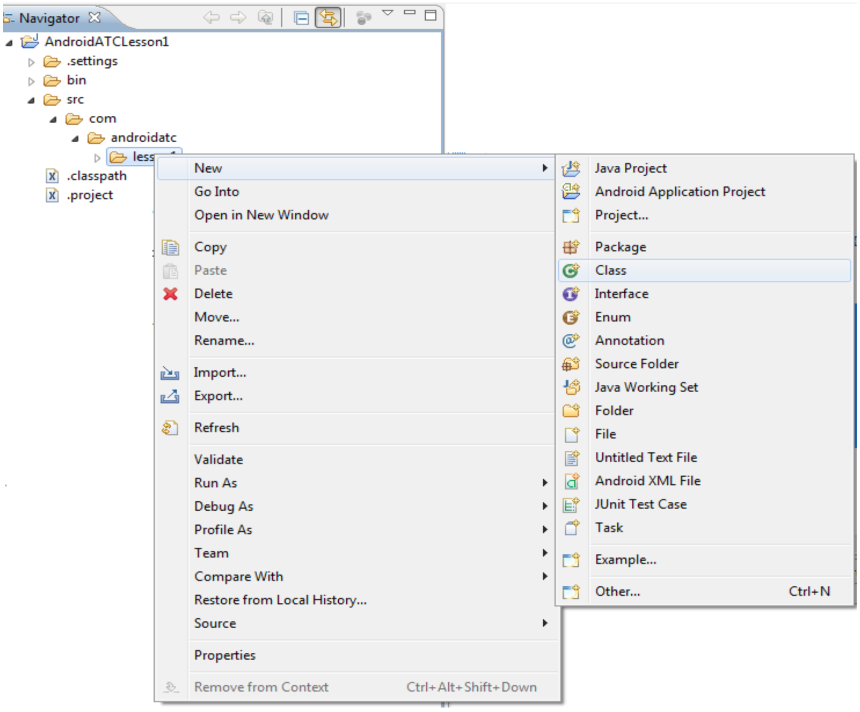
Name: com.androidatc.lesson1

d. Click on **Finish**

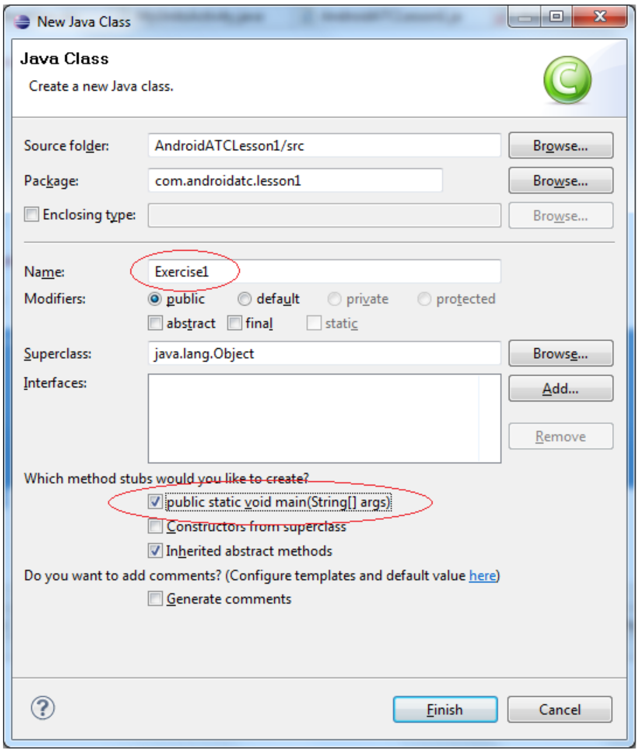
➢ Create a Java class to write your code in

a. In the Navigator view to the left of you Eclipse editor, right click on folder src

b. From the menu that shows up, point to New, and then click on Class



c. In the “New Java Class” Dialog, type *Exercise1* in field **Name**, click the checkbox next to **“public static void main(String[] args)”**



New Java Class

Java Class

Create a new Java class.

Source folder: AndroidATCLesson1/src

Package: com.androidatc.lesson1

□ Enclosing type:

Name: Exercise1

Modifiers: ● public ○ default ○ private ○ protected

□ abstract □ final □ static

Superclass: java.lang.Object

Interfaces:

Which method stubs would you like to create?

☑ public static void main(String[] args)

□ Constructors from superclass

☑ Inherited abstract methods

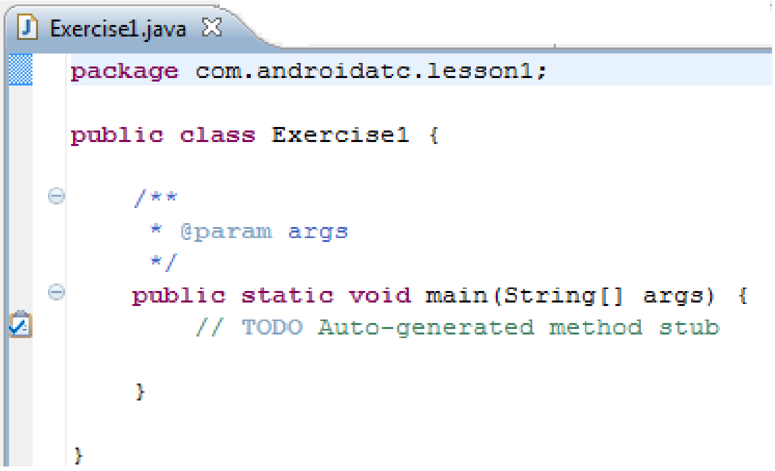
Do you want to add comments? (Configure templates and default value here)

□ Generate comments

d. Click on **Finish**

- Write the Java code to solve the exercise

   a. Eclipse automatically generates the following code and puts it in file **Exercise1.java**



```
package com.androidatc.lesson1;

public class Exercise1 {

    /**
     * @param args
     */
    public static void main(String[] args) {
        // TODO Auto-generated method stub

    }

}
```

   b. Inside method main(), type the following lines of code:

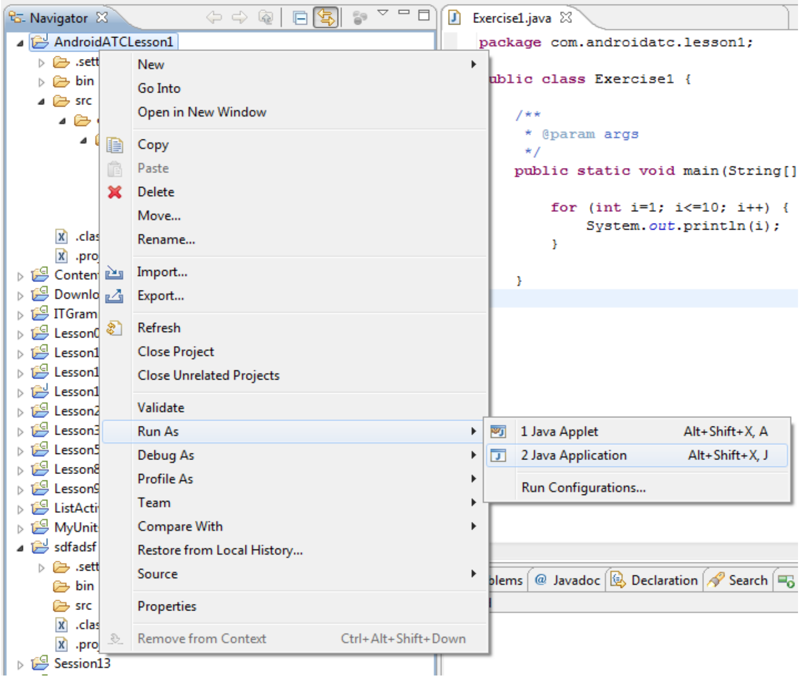
```
for (int i=1; i<=10; i++) {

        System.out.println(i);

}
```

   c. Click on save button to save your file.

- Run your Java program

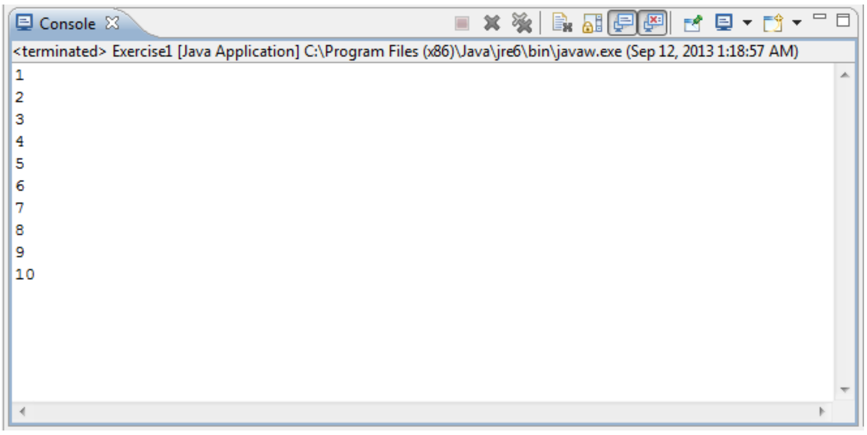
   a. Right-click on the project name under the Navigator pane.

   b. In the Menu that shows up, point to "Run As", then click on **Java Application**



```
package com.androidatc.lesson1;

ublic class Exercise1 {

    /**
     * @param args
     */
    public static void main(String[]

        for (int i=1; i<=10; i++) {
            System.out.println(i);
        }

    }
```

c. Check the console view. You should see the numbers printed out



```
<terminated> Exercise1 [Java Application] C:\Program Files (x86)\Java\jre6\bin\javaw.exe (Sep 12, 2013 1:18:57 AM)
1
2
3
4
5
6
7
8
9
10
```

Lesson 2: Object Oriented Programming

Introduction

Java is an object-oriented programming (OOP) language. This lesson will cover the basic principles and features of OOP and provides some code examples.

Object Oriented Programming

Java is an object oriented programming (OOP) language. It shares with other OOP languages the same concepts and features. This lesson will introduce you to objects, classes, inheritance, and interfaces.

Objects

An object is a software bundle of related state and behavior. Software objects are often used to represent real-world objects we find in real life. Objects are essential to understanding object-oriented programming. Real world objects share two characteristics: state and behavior. For example, a car has a state (current model, maker, color) and behavior (driving, changing gear …etc.)

Building your code into a separate software object provides many benefits, including code re-use, information hiding, ease of debugging…etc.

Classes

A class is a prototype from which objects are created. This section defines a class that models the state and behavior of a real-world object. Classes provide a clean way to model the state and behavior of real world objects.

Two main properties of define a class: a set of member **variables** (also called **fields**), and a set of member **methods** (or **functions**).

Methods and functions means the same thing in the context of object oriented programming and they are used interchangeably in this course.

To represent an object's state in classes, add member variables to a class. Behaviors of objects are represented using methods. The following is a simple Java class called Vehicle.

```
class Vehicle {
	int speed = 0;
	int gear = 1;

	void changeGear(int newGear) {
		gear = newGear;
	}

	void speedUp(int increment) {
		speed = speed + increment;
	}

	void printStates() {
		System.out.println(" speed:" + speed + " gear:" + gear);
	}
}
```

The state of the Vehicle object is represented with the variables speed and gear. The behavior of the object can be changed using the two methods **changeGear()** and **speedUp().**

Getters and setters

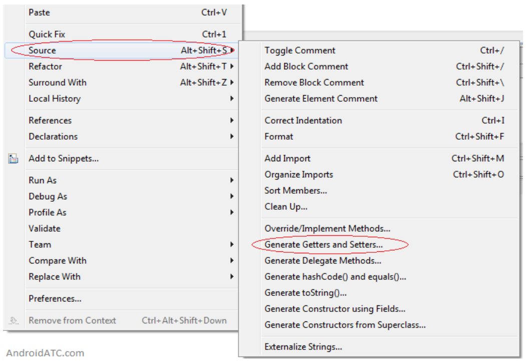
A set of methods are usually created in a class to specifically read/write the values of member variables. These are called getters - used to get the values – and setters – used to change the values of member variables.

Getters and setters are crucial in Java classes as they are used to manage the state of an object. In the Vehicle class provided previously, we can add two methods (a getter and a setter) for each member variable. The following is the full code of the class after adding the getters and setters:

```
class Vehicle {
	int speed = 0;
	int gear = 1;

       // Start of getters and setters
	public int getSpeed() {
		return speed;
	}

	public void setSpeed(int s) {
		speed = s;
	}

	public int getGear() {
		return gear;
	}

	public void setGear(int g) {
		gear = g;
	}
	// End of getters and setters

	void changeGear(int newGear) {
```

```
            gear = newGear;
      }

      void speedUp(int increment) {
            speed = speed + increment;
      }

      void printStates() {
            System.out.println(" speed:" + speed + " gear:" + gear);
      }
}
```

You can let Eclipse generate getters and setters for you. Right click inside a class code and choose **Source** then **Generate Getters and Setters,** as in the screen capter:


Paste Ctrl+V
Quick Fix Ctrl+1
Source Alt+Shift+S
Refactor Alt+Shift+T
Surround With Alt+Shift+Z
Local History
References
Declarations
Add to Snippets...
Run As
Debug As
Profile As
Validate
Team
Compare With
Replace With
Preferences...
Remove from Context Ctrl+Alt+Shift+Down
Toggle Comment Ctrl+/
Add Block Comment Ctrl+Shift+/
Remove Block Comment Ctrl+Shift+\
Generate Element Comment Alt+Shift+J
Correct Indentation Ctrl+I
Format Ctrl+Shift+F
Add Import Ctrl+Shift+M
Organize Imports Ctrl+Shift+O
Sort Members...
Clean Up...
Override/Implement Methods...
Generate Getters and Setters...
Generate Delegate Methods...
Generate hashCode() and equals()...
Generate toString()...
Generate Constructor using Fields...
Generate Constructors from Superclass...
Externalize Strings...
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Inheritance

Inheritance provides a powerful and natural mechanism for organizing and structuring your software. It set a parent-child relationship between two different objects.

Object-oriented programming allows classes to inherit commonly used state and behavior from other classes. In following example, Vehicle becomes the parent (superclass) of Truck and Car. In the Java programming language, each class is allowed to have one direct superclass, and each superclass has the potential for an unlimited number of subclasses.

```
public class Car extends Vehicle {
      int numOfSeats;
      //Set of statements defining
      //a car's state and behavior
}


public class Truck extends Vehicle {
      public int loadWeight;
      //Set of statements defining
      //a truck's state and behavior
}
```

The Car and Truck now share the same state and behavior defined in class vehicle.

Keywords this and super

Two Java keywords you might encounter when writing you class code with inheritance: **this** and **super.** Keyword **this** is used as a reference to the current class itself, while **super** is a reference to the parent class that **this** class inherent from. In other words, **super** is used to access member variables and methods of the parent class.

Keyword **super** is especially useful when you want to override a superclass's method in a child class but you want to invoke the superclass's method. For example, in class Car, you can override method *printStates()* and call Vehicle's *printStates():*

```
public class Car extends Vehicle {
      int numOfSeats;

      void printStates() {
            super.printStates();
            System.out.println(" Number of Seats:" + numOfSeat);
      }
}
```

Calling Car's *printStates()* method will invoke first Vehicle's *printStates()*, then the print out statement.

Interface

An interface is a contract between a class and the outside world. When a class implements an interface, it must provide the behavior specified by that interface. Let's take the Vehicle example above, and create an interface for it.

```
 public interface IVehicle {
           void changeGear(int newValue);
           void speedUp(int increment);
 }
```

Then the Vehicle class implements the IVehicle interface using following syntax:

```
 class Vehicle implements IVehicle {
       int speed = 0;
       int gear = 1;

       public void changeGear(int newValue) {
             gear = newValue;
       }

       public void speedUp(int increment) {
             speed = speed + increment;
       }

       void printStates() {
             System.out.println(" speed:" + speed + " gear:" + gear);
       }
 }
```

Note that class Car must provide and implementation for methods *changeGear()* and *speedUp()*.

Access Modifiers

Access modifiers determine whether other classes can use a particular field or invoke a particular method. There are four types of access control:

- At the class level—public, or default (no explicit modifier).
- At the member level—public, private, protected, or default (no explicit modifier).

A class may be declared with the modifier public, in which case that class is visible to all classes everywhere. If a class has no modifier (the default), it is visible only within its own package (packages are named groups of related classes.)

At the member level, in addition to the public modifier or no modifier (package-private), there are two additional access modifiers: private and protected. The private modifier specifies that the member can only be accessed in its own class. The protected modifier specifies that the member can only be accessed within its own package and, in addition, by any other subclass of its class.

Access Levels				
Modifier	**Class**	**Package**	**Subclass**	**All Other**
public	**Y**	**Y**	**Y**	**Y**
protected	**Y**	**Y**	**Y**	**N**
Default	**Y**	**Y**	**N**	**N**
private	**Y**	**N**	**N**	**N**

Constructors

Constructors are invoked to create objects. They are similar to functions but differentiated by the following:

- Constructors have the same name as the class
- They do not have any return type.

Calling a constructor to create a new object would initialize an object's members. Suppose Vehicle has the following constructor:

```
public Vehicle(int s, int g){
      speed = s;
      gear = g;
}
```

Creating a new object of type Vehicle would require invoking the constructor with the **new** keyword:

```
Vehicle vehicle = new Vehicle(4, 2);
```

This line will create an object of type Vehicle and has its two members speed and gear initialized to 4 and 2 consecutively.

Method overriding and overloading

Within the same class, you can create two methods of the same name but differs in the number of arguments and their types. This is called method overloading. Note that changing the return type alone is not allowed to overload a method. You should change the parameters signature if needed.

Method overriding occurs when a class inherits a method from a super class but provides its own implementation of that method. In the following code, class car overrides method speedUp() defined in class Vehicle.

```
public class Car extends Vehicle {
      int numOfSeats;
      public void speedUp(int increment) {
            speed = speed + increment + 2;
      }
}
```

Suppose you create an object of type car and called the speedUp(). Then, the Vehicle's method is ignored and the one inside class Car is executed:

```
Car car = new Car();
car.speedUp(2);
```

Polymorphism

In the context of object-oriented programming, polymorphism means that different subclasses of the same parent class can have different behaviors, yet share some of the functionalities of the parent class.

To demonstrate polymorphism, we will add method showInfo() to class Vehicle. This method prints all info in an object of type Vehicle:

```
public void showInfo() {
      System.out.println("The vehicle has a speed of: " + this.speed
                  + " and at gear " + this.gear);
}
```

However, if the Truck subclass uses this method, the member variable *loadWeight* will not be printed out, since it's not a member of the parent class Vehicle. We resolve this, we can override method *showInfo()* as follows:

```
public void showInfo() {
            super.showInfo();
            System.out.println("The truck has is carrying a load of: "
                        + this.loadWeight);
}
```

Notice that Truck's method *showInfo()*, will call the parent's *showInfo()* and add to it its own behavior – which prints the value of *loadWeight*.

We can do the same thing with class car.

```
public void showInfo() {
      super.showInfo();
      System.out.println("The car has "
                  + this.numOfSeats + " seats.");
}
```

Now, to test the polymorphic behavior, we will create 3 objects, each of different type of Vehicle:

```
class Lesson1Array {
      public static void main(String[] args) {

            Vehicle vehicle1, vehicle2, vehicle3;

            vehicle1 = new Vehicle(50,2);
            vehicle2 = new Car(50,2,4);
            vehicle3 = new Truck(40,2,500);

            System.out.println("Vehicle 1 info:");
            vehicle1.showInfo();

            System.out.println("\nVehicle 2 info:");
            vehicle2.showInfo();
```

```
        System.out.println("\nVehicle 3 info:");
        vehicle3.showInfo();
    }
}
```

Once we run this class, we have three different output statements.

```
Vehicle 1 info:
The vehicle has a speed of: 50 and at gear 2

Vehicle 2 info:
The vehicle has a speed of: 50 and at gear 2
The car has 4 seats.

Vehicle 3 info:
The vehicle has a speed of: 40 and at gear 2
The truck has is carrying a load of: 500
```

In the above example, JVM has called each object’s method instead of calling Vehicle’s object for all three objects.

Lab 2

Objectives

- Implement parent-child relationship in Java
- Understand method overriding
- Understand method overloading

Pre-requisites

You need to create a new Java project under Eclipse before solving these exercises. Follow the steps detailed in Lesson 1 of this book.

Exercise

Create a Java project made up of two classes and one interface: Parent class that implements the interface, and Child class which extends Parent. Override a method in Parent, and overload another one in Child.

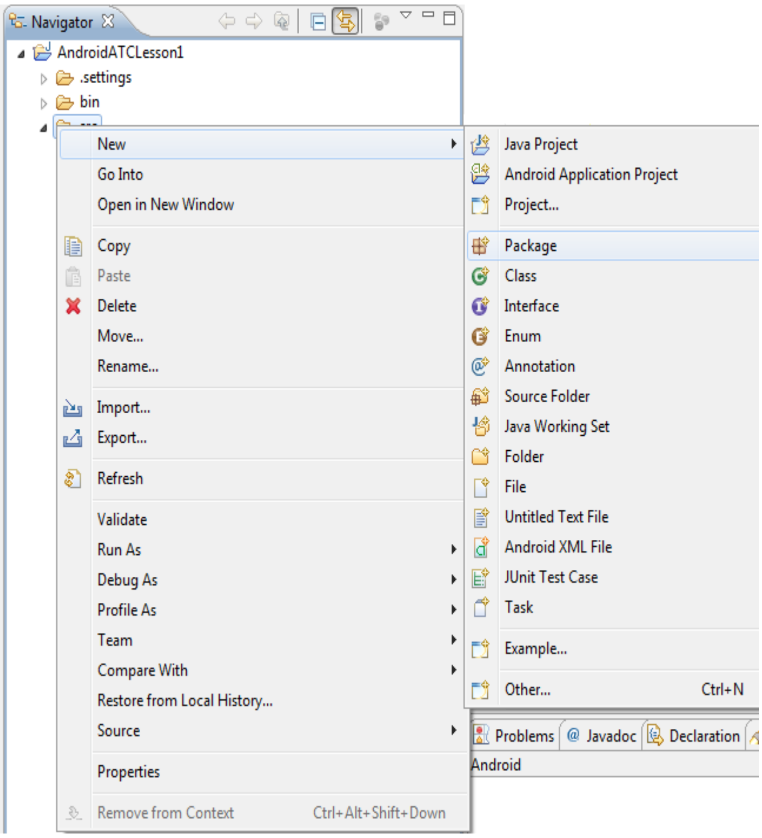
➢ Create a new Java project under Eclipse

a. Follow the steps to create a new project as explained in section "**Creating a Java project**" of Lab 1.

➢ Create a Java package

a. In the Navigator view to the left of you Eclipse editor, right click on folder **src**

b. In menu that shows up, point to **New**, and then choose **Package**.



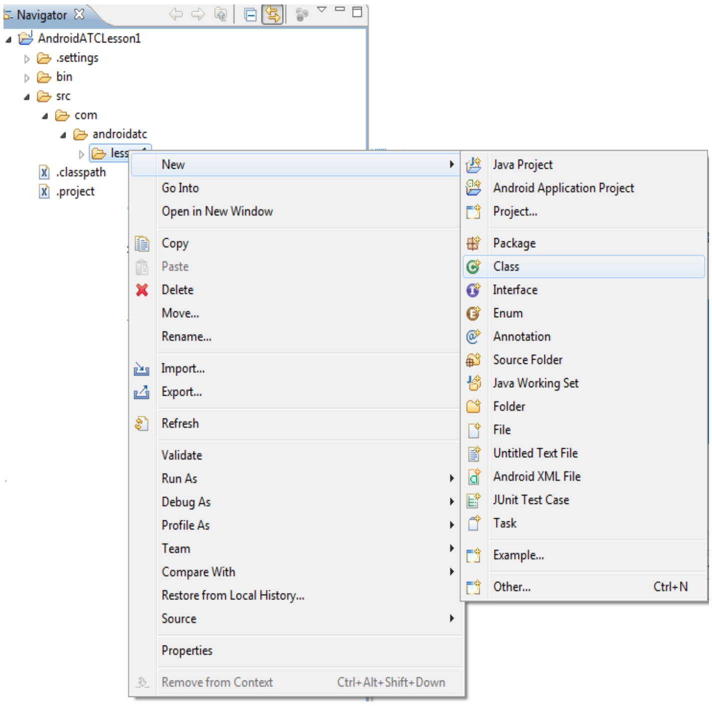
c. In the "**New Java Package**" dialog, type in the field Name the following: *com.androidatc.lesson2*

d. Click on **Finish**

Create two Java classes to write your code in

a. In the Navigator view to the left of you Eclipse editor, right click on folder **src**.

b. From the menu that shows up, point to New, and then click on Class



c. In the "**New Java Class**" Dialog, type *Parent* in field **Name**

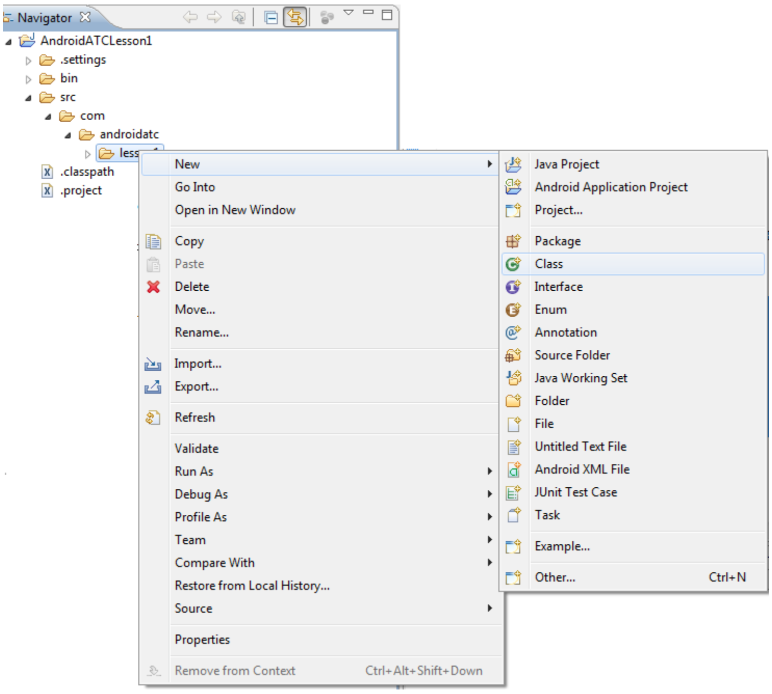
d. Click **Finish**

e. Repeat steps **a** to **d**, but in step **c** type *Child* in field **Name**

Create a Java interface

a. In the Navigator view to the left of you Eclipse editor, right click on folder **src**

b. From the menu that shows up, point to New, and then click on **Interface**



c. In the “**New Java Interface**” Dialog, type ***IParent*** in field **Name**

d. Click **Finish**

- Write the Java code to solve the exercise

a. Open file Parent.java

b. Type in it the following code

```
package com.androidatc.lesson1;
public class Parent implements IParent {

    public void firstMethod(int i) {
    }
    public void secondMethod(int i) {
    }
}
```

c. Open file **Child.java**

d. Type in the following code

```
package com.androidatc.lesson1;
public class Child extends Parent{

    public void firstMethod(int i) {
    }
    public void thirdMethod(int i) {
    }
    public void thirdMethod(int i, int n) {
    }
}
```

e. Open file **IParent.java**

f. Type in the following code

```
package com.androidatc.lesson1;
public interface IParent {
   void secondMethod(int i);
}
```

Method **firstMethod()** in class **Child** overrides method **firstMethod()** of class **Parent**.

Method **thirdMehod()** in class **Child** is overloaded.

Lesson 3: More Java Programming

Introduction

After covering the basic object oriented programming principles in the previous lesson, this lesson will cover additional topics you would probably face during Java coding.

Exceptions

Handling errors is an essential part of writing a robust code. Java uses exceptions to handle errors. This section explains exceptions and how to use them.

When an error occurs, the Java runtime environment handles an error object that is created by the method where the error occurs. This object is called exception, and contains basic information about the error (like the type of the error, the location, the stack of methods that lead to the error…etc.). The process of creating an exception object and handling it by the system is called throwing an exception.

The list of methods that lead to the error is called “the call stack”. When handling the error, the system searches through that stack to find an error handler in the code; i.e. exception handler. All exception objects are children of the parent class **Exception.** The different types or errors thrown are children of class Exception.

Exceptions in Java can be categorized into three types:

Exception Category	Description
Checked Exception	These are errors inside the application’s code and a programmer who intends to create a robust well-written code is expected to recover from these errors. For example, reading from a file on the disk, a programmer should expect is non-existent. In this case, the programmer should expect a `java.io.FileNotFoundException`, thrown, and thereafter catch this exception and notify the user of a proper action.
Unchecked Exception	These come in two types themselves: Errors and Runtime exceptions. They are grouped in one category because both cannot be anticipated or recover from by a programmer. Errors are external to the applications. For example, suppose that an application successfully opens a file for input, but is

	unable to read the file because of a hardware or system malfunction. The unsuccessful read will throw `java.io.IOError`, and it makes sense for the program to print a stack trace and exit. Errors are those exceptions of type Error class and its sub-classes. Runtime exceptions usually indicate programming bugs such as logic errors. They are or type `RuntimeException` class and its subclasses.

Handling errors (exceptions) in Java is done through the try-catch-finally blocks. While the finally block is optional, the try and catch are obligatory to fulfill error handling.

Let's look at the following code:

```
1. public class AndroidATCLesson3 {
2.   public static void main(String[] args) {
3.           System.out.println("Hello World from Android ATC!");
4.           String nullString = null;
5.           System.out.println("Entered try statement");
6.           String partialString = nullString.substring(1);
7.           // Execution will break before reaching this line
8.           System.out.println("Partial string is: " + partialString);
9.     }
10. }
```

Running the code above will result in an error thrown of type *NullPointerException*, specifically at line 6, where we are trying to read from a string object that is null (not initialized)

To properly handle this error, we should modify the above code to become:

```
1. public class AndroidATCLesson3 {
2.         public static void main(String[] args) {
3.         System.out.println("Hello World from Android ATC!");
4.         String nullString = null;
5.         try {
6.                 System.out.println("Entered try statement");
7.                 String partialString = nullString.substring(1);
8.                 // Execution will continue in the exception block
9.                 System.out.println("Partial string is: "+partialString);
```

```
            } catch (Exception e) {
                System.out.println("Error occured: "+e.getMessage());
                e.printStackTrace();
            }
        }
}
```

Instead of breaking the code execution and halting the program, this code will handle the *NullPointerException* properly by printing the error details and continuing execution past the catch block.

The finally block can be used after the exception block. This block of code will always run whether there is an exception thrown or not.

```
try {
      System.out.println("Entered try statement");
      String partialString = nullString.substring(1);
      // Execution will break before reaching this line
      System.out.println("Partial string is: " + partialString);
} catch (Exception e) {
      System.out.println("Error occured: "+e.getMessage());
      e.printStackTrace();
} finally {
      System.out.println("This line of code will always run!");
}
```

We use *finally* block in many cases where there is some resources that need be freed but an exception might prevent us from doing so. For example, when reading from a file, a well written program should close the file after finishing reading and/or writing into it. If an exception was thrown, the line of code that closes the file might be skipped. The *finally* block would be the best place to close the file in.

Java Collections

Java provides a set of classes and interfaces to help developers handle a collection of objects. These collection classes similar to an array, except their size can grow dynamically during run time. This section will provide an overview of some of the more popular Java collection classes.

Interfaces

Java collections are mainly located in package java.util. It provides two main Interfaces: Collection and Map. These two are the core of the Java Collection framework. Other interfaces inherit from these two. For example, the List and Set interfaces inherit from Collection interface. All of these interfaces are generic; i.e. the type of the object contained in the collection should be specified by the programmer. There is a main difference between subclasses of Collection interface and those of Map interface.

The collection contains a group of objects that can be manipulated and passed around. The elements can be duplicated or unique, depending on the type of sub-class. For example, a Set only contains unique objects.

The Map interface, however, maps keys to values and cannot contain duplicate keys and each key can only map one value at most.

Implementations

Implementations are the data objects used to store collections, which implement the previous section. This lesson describes the following implementations:

ArrayList

An Arraylist is a resizable-array implementation of the `List` interface. It implements all optional list operations, and permits all elements, including `null`. It also provides methods to manipulate the size of the array that is used internally to store the list.

```
import java.util.*;
class TestArrayList {
      public static void main(String args[]) {
            // Creating an array list
            ArrayList<String> androids = new ArrayList<String>();
            // Adding elements
            androids.add("Cupcake");
            androids.add("Donut");
            androids.add("Eclair");
            androids.add("Froyo");
            androids.add("Gingerbread");
            androids.add("Honeycomb");
            androids.add("Ice Cream Sandwich");
            androids.add("Jelly Bean");

            System.out.println("Size of ArrayList: " + androids.size());
            // Display the contents of the array list
            System.out.println("The ArrayList has the following elements: "
                                  + androids);
            // Remove elements from the array list
```

```
        System.out.println("Deleting second element...");
        androids.remove(3);
        System.out.println("Size after deletions: " + androids.size());
        System.out.println("Contents after deletions: " + androids);
    }
}
```

The following is the output of the program:

```
Size of ArrayList: 8
The ArrayList has the following elements: [Cupcake, Donut, Eclair, Froyo,
Gingerbread, Honeycomb, Ice Cream Sandwich, Jelly Bean]
Deleting second element...
Size after deletions: 7
Contents after deletions: [Cupcake, Donut, Eclair, Gingerbread, Honeycomb,
Ice Cream Sandwich, Jelly Bean]
```

HashSet

This class implements the `Set` interface and permits the `null` element. This collection does not allow duplicates. It creates a collection that uses a hash table for storage. A hash table stores information by using a mechanism called hashing where the value stored is used to determine a unique key, which is used as the index at which the data is stored. The advantage of hashing is that it allows fast execution times for basic operations, like add( ) and remove().

The following is an example of HashSet.

```
class TestHashSet {
    public static void main(String args[]) {
        // Creating a HashSet
        HashSet<String> androids = new HashSet<String>();
        // Adding elements
        androids.add("Cupcake");
        androids.add("Cupcake");
        androids.add("Eclair");
        androids.add("Eclair");
        androids.add("Gingerbread");
        androids.add("Honeycomb");
        androids.add("Ice Cream Sandwich");
        androids.add("Jelly Bean");
        System.out.println("The contents of the HashSet: "+androids);
    }
}
```

The output of the program is:

```
The contents of the HashSet: [Eclair, Cupcake, Honeycomb, Ice Cream Sandwich,
Jelly Bean, Gingerbread]
```

Notice that there is one “Cupcake” element and one “Éclair” element in the HashSet although each was added twice in the code.

HashMap

This is a hash table based implementation of the Map interface. It allows null elements and does not add any methods of its own.

The following program illustrates HashMap. It maps names to account balances.

```
import java.util.*;

class TestHashMap {
    public static void main(String args[]) {
        // Creating a HashMap
        HashMap<String,Double> androids = new HashMap<String,Double>();
        // Adding elements
        androids.put("Cupcake", new Double(1.5) );
        androids.put("Donut",new Double(1.6));
        androids.put("Eclair", new Double(2.1));
        androids.put("Froyo", new Double(2.2));
        androids.put("Gingerbread", new Double(2.3));
        androids.put("Honeycomb", new Double(3.1));
        androids.put("Ice Cream Sandwich", new Double(4.0));
        androids.put("Jelly Bean", new Double(4.1));
        // Get a set of the entries
        Set<Map.Entry<String, Double>> set = androids.entrySet();
        // Get an iterator
        Iterator<Map.Entry<String, Double>> i = set.iterator();
        // Display elements
        while (i.hasNext()) {
            Map.Entry<String, Double> me = (Map.Entry<String,Double>)
                                                 i.next();
            System.out.print(me.getKey() + ": ");
            System.out.println(me.getValue());
        }
        System.out.println();
        // Increase version number of Eclair
        Double version = androids.get("Eclair");
        androids.put("Eclair", new Double(version + 0.1));
        System.out.println("New version number of Eclair: "
                                + androids.get("Eclair"));
    }
}
```

The output of the program is:

```
Eclair: 2.1
Cupcake: 1.5
Honeycomb: 3.1
Froyo: 2.2
Donut: 1.6
Ice Cream Sandwich: 4.0
Jelly Bean: 4.1
Gingerbread: 2.3

New version number of Eclair: 2.2
```

Lab 3

Objectives

- Write code that uses ArrayList methods.
- Read strings from a file
- Learning the benefits of the Set collection.

Pre-requisites

You need to create a new Java project under Eclipse before solving these exercises. Follow the steps detailed in Lesson 1 of this book.

Exercise

Write a program that saves ten strings in an ArrayList. The strings have the following format: “Element – X”, where X is a number between 1 and 10. Demonstrate the usage of methods: **add()**, **remove()**, and **indexOf()**.

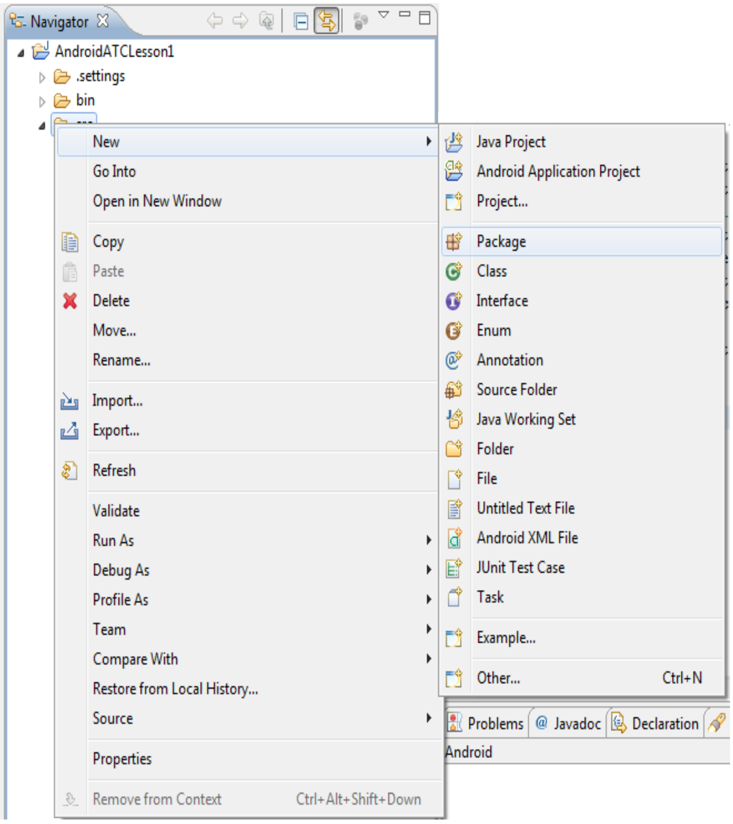
- ### Create a new Java project under Eclipse

  a. Follow the steps to create a new project as explained in section “**Creating a Java project**” of Lab 1

- ### Create a Java package

  a. In the Navigator view to the left of you Eclipse editor, right click on folder **src**

  b. In menu that shows up, point to New, and then choose **Package**.



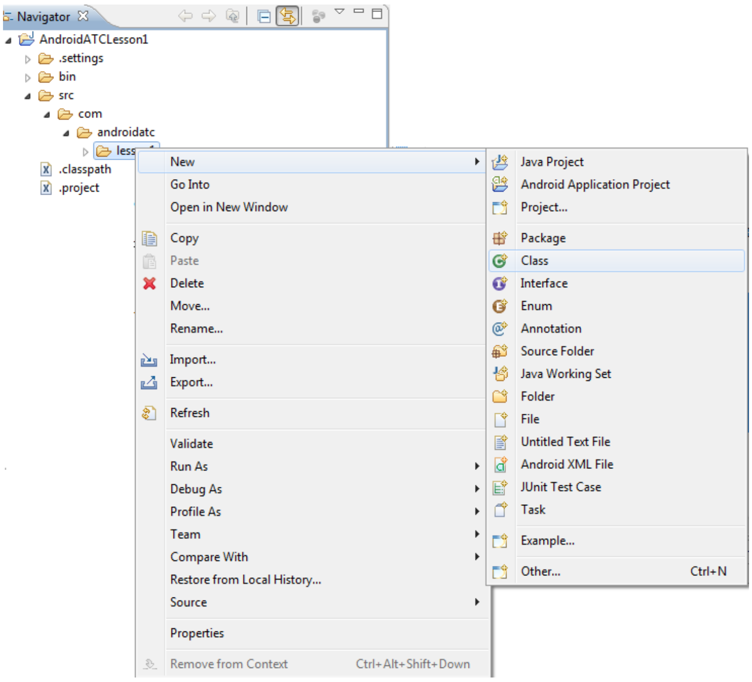
  c. In the “**New Java Package**” dialog, type in the field Name the following: *com.androidatc.lesson3*

  d. Click on **Finish**

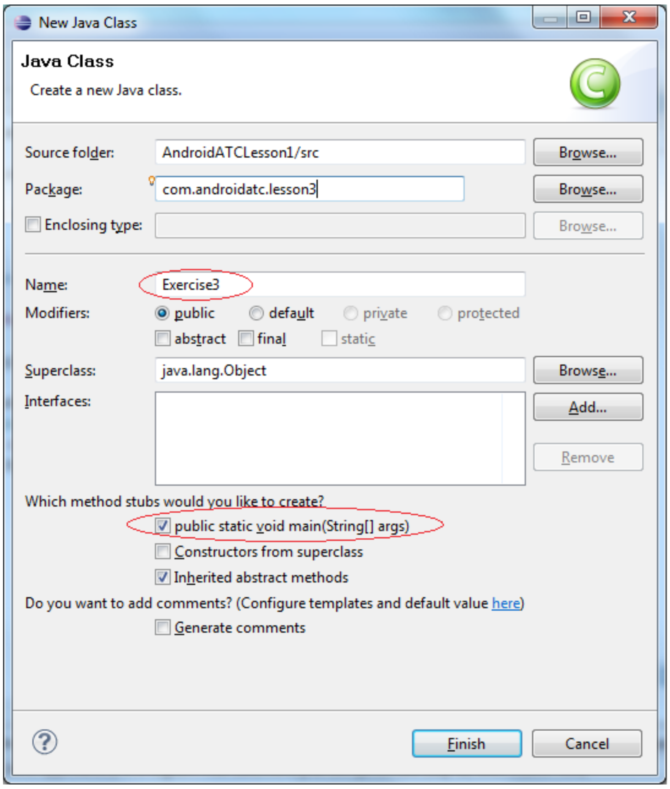
➢ Create a Java class to write your code in

a. In the Navigator view to the left of you Eclipse editor, right click on folder **src.**

b. From the menu that shows up, point to New, and then click on **Class**



c. In the “New Java Class” Dialog, type *Exercise3* in field **Name**, click the checkbox next to **“public static void main(String[] args)”**


New Java Class

Java Class

Create a new Java class.

Source folder: AndroidATCLesson1/src Browse...

Package: com.androidatc.lesson3 Browse...

□ Enclosing type: Browse...

Name: Exercise3

Modifiers: ● public ○ default ○ private ○ protected

□ abstract □ final □ static

Superclass: java.lang.Object Browse...

Interfaces: Add... Remove

Which method stubs would you like to create?

☑ public static void main(String[] args)

□ Constructors from superclass

☑ Inherited abstract methods

Do you want to add comments? (Configure templates and default value here)

□ Generate comments

Finish Cancel

d. Click on **Finish**

➢ Write the Java code to solve the exercise

a. Open file Exercise3.java

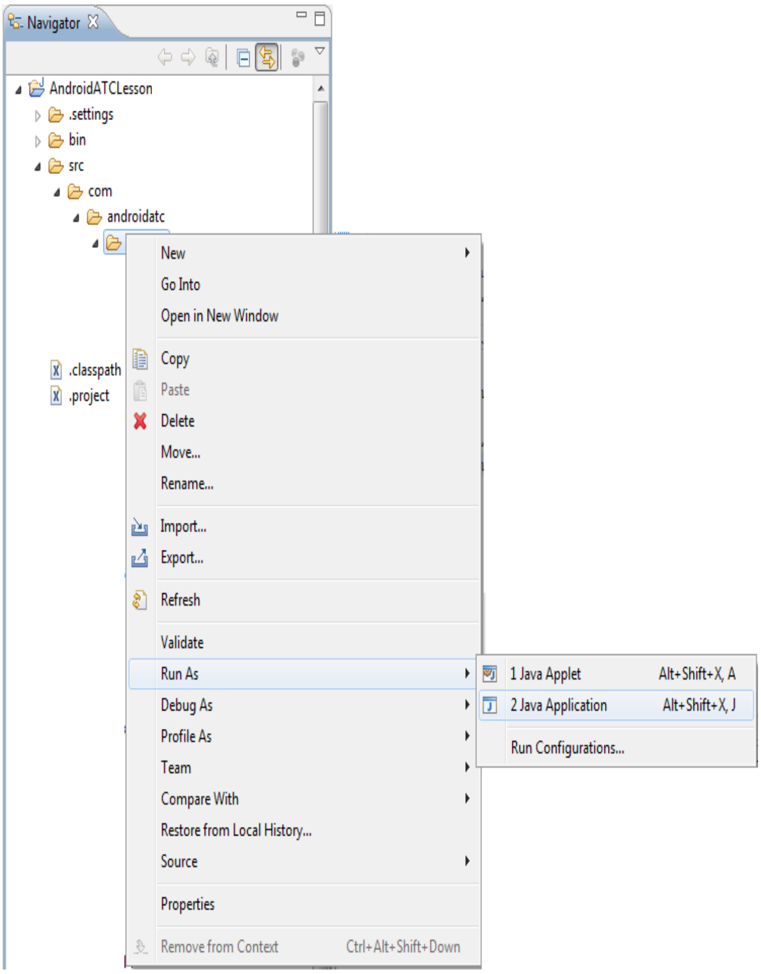
b. Type inside method main() the following code:

```
ArrayList<String> arrayList = new ArrayList<String>();
for (int i = 1; i <= 10; i++) {
    arrayList.add("Element - " + i);
}
System.out.println("Index of Element 6: " +arrayList.indexOf("Element - 6"));
arrayList.remove(4);
System.out.println("Index of Element 6: "+ arrayList.indexOf("Element - 6"));
```

➢ Run your Java program

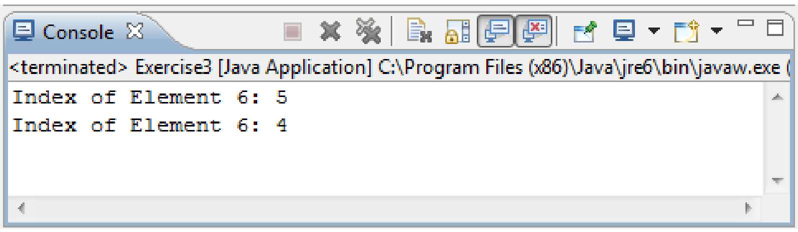
a. Right-click on the project name under the Navigator pane.

b. In the Menu that shows up, point to “Run As”, then click on **Java Application**



- **Check the console view.**

You should see the desired output.



```
<terminated> Exercise3 [Java Application] C:\Program Files (x86)\Java\jre6\bin\javaw.exe (
Index of Element 6: 5
Index of Element 6: 4
```

Lesson 4: Java Topics

Introduction

This lesson will delve into another set of OOP features and Java-specific topics.

Nested Classes

Using Java, you can define a class within another class. These are called nested classes:

```
class OuterClass {
    ...
    class NestedClass {
        ...
    }
}
```

Nested classes can be static and called static inner classes.

```
class OuterClass {
      ...
      static class StaticInnerClass {
          ...
      }
      class InnerClass {
          ...
      }
}
```

A nested class is a member of its enclosing class. Non-static inner classes have access to other members of the outer class, even if they are declared private. However, static inner classes do not. Similar to member variables and methods, an inner class can be declared `private`, `public`, `protected`, or *package private*.

Benefits of inner classes

The following are some reasons that tempt a programmer to use inner classes:

- **Improve logical grouping of classes** that are only used in one place. If a class B is useful to only one other Class A, then it is logical to make class B an inner class of class A.

- **Increase encapsulation.** If class B needs to access private members of class A, a programmer can hide class B inside A and keep all members of A private, and at the same time hide class B from external classes.

- **Improve code readability and maintainability.** Creating inner classes within an outer class provides a clearer placement of code.

Class Variables (static)

When we create several objects of the same class, each object (instance) has its own distinct copy of member variables. Sometimes, we might want a variable that is common to all objects of the same class. To achieve this we use **static** modifier.

Member variables that have the **static** modifier in their declaration are called *static fields* or *class variables*. They are associated with the class, rather than with any object. Every instance of the class shares a class variable, which is saved in a fixed memory location. Any object can change the value of a class variable, but class variables can also be manipulated without creating an instance of the class.

For *example*, let's modify the *Car* class of the previous lesson by adding a class variable. The member variable *numOfSeats* might have different values for different objects of type Car. However, we can add a class variable called *numberOfCars* which will be used to keep track of the number of *Car* objects created.

```
public class Car extends Vehicle {
      public int numOfSeats;
      // A class variable for the
      // number of Car objects created
      public static int numberOfCars;
       ...
}
```

Class variables are referenced by the class name itself to make it clear they are class variables, as in:

Car.numberOfCars;

You can call static variables with an object variable:
car1.numberOfCars;
… but this is not recommended since the class variable will look like a regular member variable.

Class Methods

Java also supports static methods as well as static variables. Static methods, which have the `static` modifier in their signature, should be invoked with the class name, without the need for creating an instance of the class, as in

```
ClassName.methodName(args)
```

You can also call static methods with an object reference:

car1.getNumberOfCars();

... but this is not recommended since the class variable will look like a regular member variable.

A common use for static methods is to access static fields. For example, let's modify the Car class by adding a static method that returns the numOfCars static variable:

```
    public static int getNumberOfCars(){
        return numberOfCars;
    }
```

Class methods ***cannot*** access instance variables or instance methods directly—they must use an object reference. Also, class methods cannot use the `this` keyword as there is no instance for `this` to refer to.

Enumerated types

An enumerated type (also called enumeration or enum) is a data type consisting of a set of named constants called elements or enumerators of the type. The enumerator names behave as constants in the language. A common example of enumeration is the days of the week. Because they are constants, the names of an enum type's fields are in uppercase letters.

To define an enum type in Java, we use the enum keyword. For example, the following enum type defines a set of employee title enumerations:

```
public enum Title {

    PROJECT_MANAGER,TECHNICAL_LEADER, MANAGING_DIRECTOR, CEO, CFO

}
```

Enum types should be used whenever a fixed set of constants need to be represented.

Serialization

Serialization is the process of converting an object into a format that can be stored and then converted back later to an object in the same or another computer environment.

Java provides automatic serialization which requires that the object implement the java.io.Serializable interface. Java then handles serialization internally.

The following is a Java class called Employee. It is serializable, and has three member variables: a name, an address and the enumerated type title.

```
import java.io.Serializable;

public class Employee implements Serializable {
      private String name;
      private String address;
      private Title title;

      public String getName() {
            return name;
      }
      public void setName(String name) {
            this.name = name;
      }
      public String getAddress() {
            return address;
      }
      public void setAddress(String address) {
            this.address = address;
      }
      public Title getTitle() {
            return title;
      }
      public void setTitle(Title title) {
            this.title = title;
      }
}
```

Now that we have a serializable object, we can test the serialization process by writing the object to a file on the disk. The following program writes an Employee object to a file called employee.ser

```
import java.io.FileOutputStream;
import java.io.IOException;
import java.io.ObjectOutputStream;
import java.util.ArrayList;
```

```
public class SerializeDemo {
	public static void main(String[] args) {
		Employee e = new Employee();
		e.setName("Joe");
		e.setAddress("Main Street, Joeville");
		e.setTitle(Title.PROJECT_MANAGER);

		try {
			FileOutputStream fileOut = new
FileOutputStream("c:\\employee.ser");
			ObjectOutputStream out = new ObjectOutputStream(fileOut);
			out.writeObject(e);
			System.out.println("Serialized...");
			out.close();
			fileOut.close();
		} catch (IOException i) {
			i.printStackTrace();
		}
	}
}
```

Once you run the program, you can find a file called *employee.ser* under the C: drive on a Windows machine.

Deserializing

We can now build an Employee object back from the file we have on disk, using a totally different program. All we need is to access the saved file *employee.ser*.

The following DeserializeDemo program deserializes the Employee object created in the previous section.

```
import java.io.FileInputStream;
import java.io.IOException;
import java.io.ObjectInputStream;
import java.util.ArrayList;

public class DeserializeDemo {
	@SuppressWarnings("unchecked")
	public static void main(String[] args) {
		Employee employee = new Employee();
		try {
			FileInputStream fileIn = new FileInputStream("c:\\employee.ser");
			ObjectInputStream in = new ObjectInputStream(fileIn);

			employee = (Employee) in.readObject();
			in.close();
			fileIn.close();
		} catch (IOException i) {
			i.printStackTrace();
			return;
		} catch (ClassNotFoundException c) {
			System.out.println("Employee class not found.");
			c.printStackTrace();
			return;
		} finally {

		}
		if (employee instanceof Employee) {
```

```
                  System.out.println("-----------------------");
                  System.out.println("Deserialized Employee object...");
                  System.out.println("Name: " + employee.getName());
                  System.out.println("Address: " + employee.getAddress());
                  System.out.println("Address: " + employee.getTitle());
                  System.out.println("-----------------------");
            }
      }
}
```

Once you run the DeserializeDemo program, you will get the following output:

```
-----------------------
Deserialized Employee object...
Name: Joe
Address: Main Street, Joeville
Address: PROJECT_MANAGER
-----------------------
```

Lab 4

Objectives

- Coding and using static variable and methods
- Creating Enum types

Pre-requisites

You need to create a new Java project under Eclipse before solving these exercises. Follow the steps detailed in Lesson 1 of this book.

Exercise

Create a Java class that represents a Football object. Each football is defined by three member variables: volume, weight and color (where color is only limited to three values: black, white, and blue). Also, add to the class one static variable and one static method that accesses the static variable.

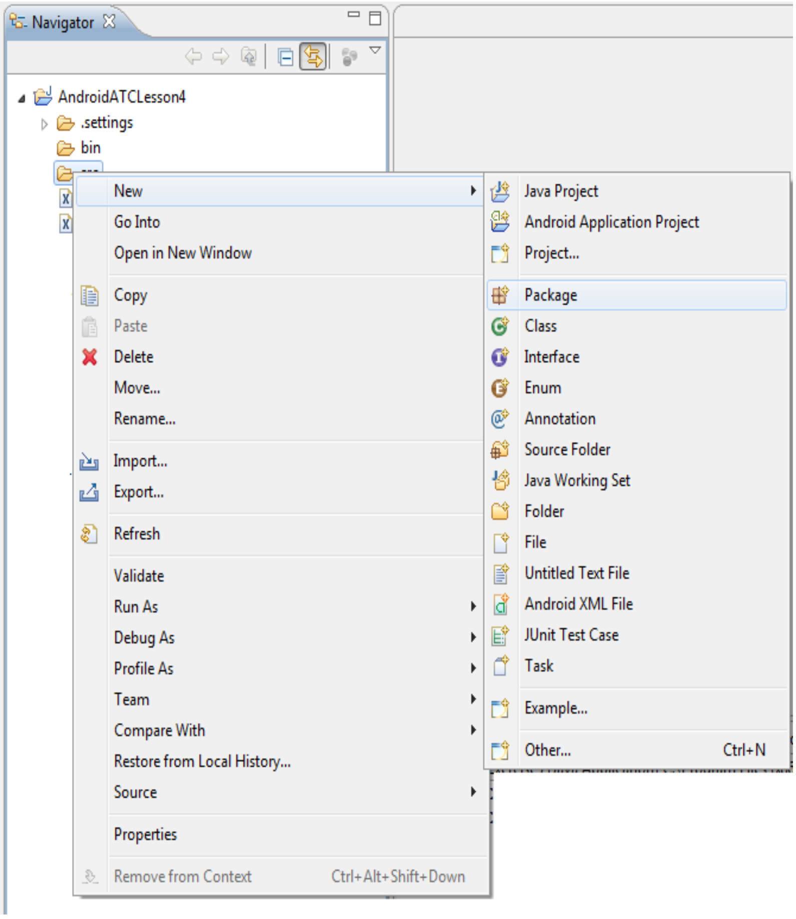
- ### Create a new Java project under Eclipse

  a. Follow the steps to create a new project as explained in section "**Creating a Java project**" of Lab 1

- ### Create a Java package

  a. In the Navigator view to the left of you Eclipse editor, right click on folder **src**

  b. In menu that shows up, point to New, and then choose **Package**.



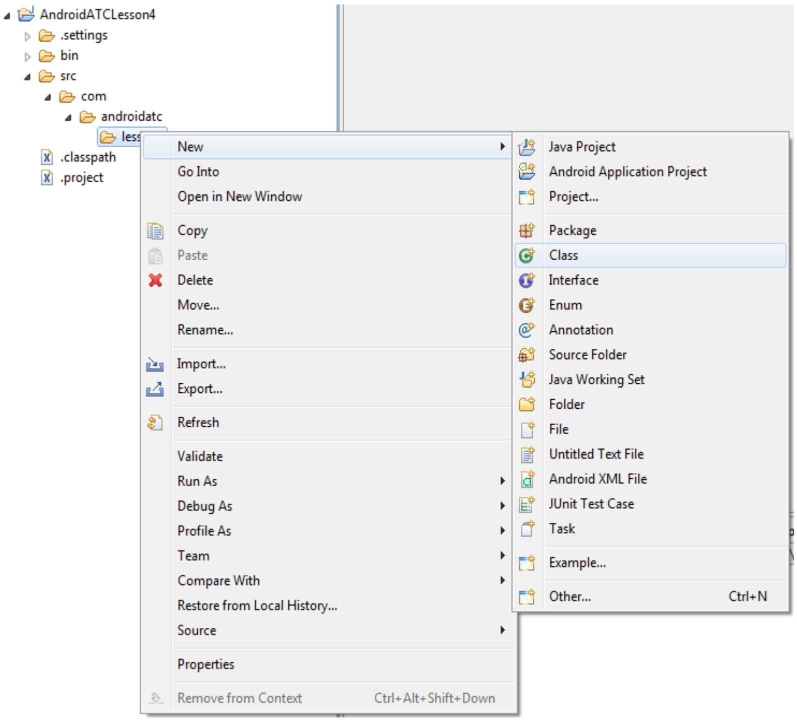
  c. In the "**New Java Package**" dialog, type in the field Name the following: *com.androidatc.lesson4*

  d. Click on **Finish**

➢ Create the Football class

a. In the Navigator view to the left of you Eclipse editor, right click on folder **src.**

b. From the menu that shows up, point to New, and then click on Class



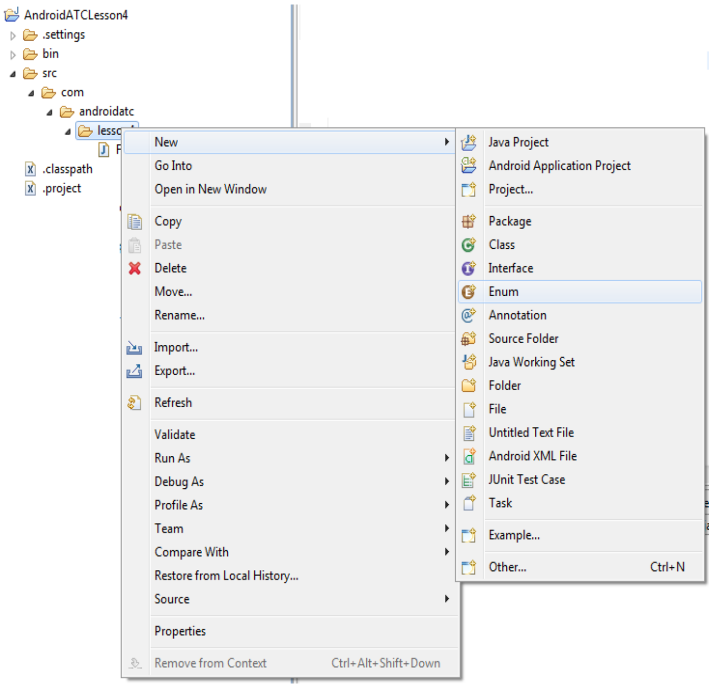
c. In the "**New Java Class**" Dialog, type *Football* in field **Name**.

d. Click on **Finish**

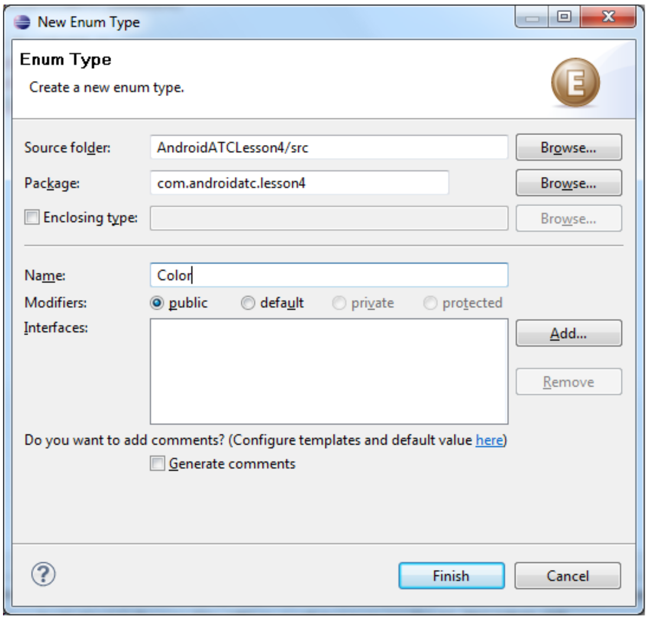
➢ Create Color Enum type

a. In the Navigator view to the left of you Eclipse editor, right click on folder **src**

b. In menu that shows up, point to New, and then choose **Enum**.



c. In the “**New Enum Type**” dialog, type *Color* in the field **Name**.



New Enum Type

Enum Type

Create a new enum type.

Source folder: AndroidATCLesson4/src

Package: com.androidatc.lesson4

□ Enclosing type:

Name: Color

Modifiers: ● public ○ default ○ private ○ protected

Interfaces:

Do you want to add comments? (Configure templates and default value here)

□ Generate comments

d. Click on **Finish**

➢ Write the Java code to solve the exercise

a. Open file Football.java

b. Type in it the following code:

```java
package com.androidatc.lesson4;

public class Football {
	private float volume;
	private float weight;
	private Color color;

	public static int numOfBalls = 0;

	public Football() {
		volume = 10;
		weight = 5;
		color = Color.WHITE;
	}

	public static int getNumOfBalls() {
		return numOfBalls;
	}

	public static void setNumOfBalls(int numOfBalls) {
		Football.numOfBalls = numOfBalls;
	}

	public float getVolume() {
		return volume;
	}

	public void setVolume(float volume) {
		this.volume = volume;
	}

	public float getWeight() {
```

```
                return weight;
        }

        public void setWeight(float weight) {
                this.weight = weight;
        }

        public Color getColor() {
                return color;
        }

        public void setColor(Color color) {
                this.color = color;
        }
}
```

c. Open file Color.java

d. Type in the following code:

```
package com.androidatc.lesson4;

public enum Color {
        BLACK,WHITE,BLUE
}
```