UNIVERSIDAD DE GUADALAJARA

CENTRO UNIVERSITARIO DE CIENCIAS EXACTAS E INGENIERÍAS

DEPARTAMENTO DE CIENCIAS COMPUTACIONALES

APUNTES DEL CURSO

PROGRAMACIÓN DE OBJETOS USANDO JAVA

ELABORADO POR

M. en Cs. Ing. Luis Alberto Muñoz Gómez

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Nota: varias imágenes pertenecen al curso SL-275 de Sun Microsystems, ed. 2002

Introducción al lenguaje

```
public class Introduccion {

     public static void main(String[] args) {
          System.out.println("Hola Mundo Java!");
          byte un=127;
          short dos=32767;
          int cuatro=0x7FFFFFFF;
          long ocho=0x7FFFFFFFFFFFFFFL;
          float flotante=2.5F;
          double doble=96.08;
          final double PI=3.1416;
          boolean sonBienvenidos=true;
          System.out.println(un);
          System.out.println(dos);
          System.out.println(cuatro);
          System.out.println(ocho);
          System.out.println(flotante);
          System.out.println(doble);
          System.out.println(PI);
          System.out.println(sonBienvenidos);
          String s1="Bienvenidos.";
          String s2="Estructuras "+
                         "de "+
                         "Datos "+
                         "I";
          if (sonBienvenidos){
               System.out.println(s1);
               System.out.println(s2);
          }
          //else siempre son bienvenidos
          System.out.printf("PI=%f\n",PI);
          //operador condicional
          s1=sonBienvenidos?"Si":"No";
          System.out.println(s1);
          System.out.println(sonBienvenidos?"Si":"No");
     }

}

//lenguaje C
int a=20,b=10,c;
c=a-b;
printf("la resta %d-%d=%d",a,b,c); //la resta 20-10=10

//lenguaje Java
System.out.println("la resta "+a+"-"+b+"="+c);
System.out.println("var1="+a+",var2="+b)
```

Almacenamiento de Objetos
Arreglos
Almacenamiento de tipos primitivos en arreglos

```
int i,j;
int[] numeros=new int[4];
for(i=0;i<numeros.length;i++){
    numeros[i]=i*10;
}
System.out.println("imprimiendo arreglo de int...");
for(i=0;i<numeros.length;i++){
    System.out.println(numeros[i]);
}
```

```
char[] cars=new char[4];
for(i=0;i<cars.length;i++){
    cars[i]=(char)(65+i);
}
System.out.println("imprimiendo arreglo de chars...");
for(i=0;i<cars.length;i++){
    System.out.println(cars[i]);
}
```

```
byte[] arreglo1;
arreglo1=new byte[4];
for(i=0;i<arreglo1.length;i++){
    arreglo1[i]=(byte)(65+i);
}
System.out.println("imprimiendo arreglo de bytes #1...");
for(i=0;i<arreglo1.length;i++){
    System.out.println(arreglo1[i]);
}
```

```
byte[] arreglo2={65,66,67,68};
System.out.println("imprimiendo arreglo de bytes #2...");
for(i=0;i<arreglo2.length;i++){
    System.out.println(arreglo2[i]);
}
```

```
System.out.println("Conversión de una cadena a sus ASCII...");
String curso="TPOO";
System.out.println(curso);
byte[] cursoBytes;
cursoBytes=curso.getBytes();
System.out.println("imprimiendo valores ASCII...");
for(i=0;i<cursoBytes.length;i++){
    System.out.println(cursoBytes[i]);
}
```

```
System.out.println("imprimiendo caracteres...");
for(i=0;i<cursoBytes.length;i++){
    System.out.println((char)cursoBytes[i]);
}
```

```
System.out.println("o bien...");
for(i=0;i<cursoBytes.length;i++){
    System.out.print((char)cursoBytes[i]);
}
```

```
      System.out.println("\nCopiando arreglos e invirtiendo...");
      byte[] destino=new byte[cursoBytes.length];
      j=destino.length;
      for(i=0;i<cursoBytes.length;i++){
          j--;
          destino[j]=cursoBytes[i];
      }
      for(;j<destino.length;j++){
          System.out.print((char)destino[j]);
      }
```

Almacenamiento de objetos en arreglos

```
      System.out.println("Arreglo de Objetos:");
      String cadenas[]=new String[6];
      cadenas[0]="Curso";
      cadenas[1]="de";
      cadenas[2]="Estructuras";
      cadenas[3]="de";
      cadenas[4]="Datos";
      cadenas[5]="I";
      for(i=0;i<cadenas.length;i++){
          System.out.println(cadenas[i]);
      }
      for(i=0;i<cadenas.length;i++){
          System.out.print(cadenas[i]);
          System.out.print(" ");
      }
```

```
  public static void main(String args[]){
      if (args.length>0){
          for(i=0;i<args.length;i++){
              System.out.println(args[i]);
          }
      }
  }
```

Comunicación entre objetos

```
class Circulo{
     private double radio;
     private int colorBorde;
     private int colorFondo;
     private final double PI=3.1416;

     public void fijaRadio(double radiox){
          radio=radiox;
     }

     public void fijaColorBorde(int colorBordex){
          colorBorde=colorBordex;
     }

     public void fijaColorFondo(int colorFondox){
          colorFondo=colorFondox;
     }

     public double dameRadio(){
          return radio;
     }

     public int dameColorBorde(){
          return colorBorde;
     }

     public int dameColorFondo(){
          return colorFondo;
     }

     public double dameArea(){
          return PI*radio*radio;
     }

     public boolean esIgualA(Circulo c){
          boolean resultado;
          if (radio==c.dameRadio() &&
               colorBorde==c.dameColorBorde() &&
               colorFondo==c.dameColorFondo()){
               resultado=true;
          }
          else{
               resultado=false;
          }
          return resultado;
     }
}
```

```
public class Comunicacion {

     public static void main(String[] args) {
          Circulo c1=new Circulo();
          c1.fijaRadio(10);
          c1.fijaColorBorde(11);
          c1.fijaColorFondo(14);
          Circulo c2=new Circulo();
          c2.fijaRadio(10);
          c2.fijaColorBorde(11);
          c2.fijaColorFondo(14);
          Circulo c3=new Circulo();
          c3.fijaRadio(10);
          c3.fijaColorBorde(4);
          c3.fijaColorFondo(14);
          if (c1.esIgualA(c2)){
               System.out.println("c1 y c2 son iguales");
          }
          else{
               System.out.println("c1 y c2 son diferentes");
          }
          if (c2.esIgualA(c3)){
               System.out.println("c2 y c3 son iguales");
          }
          else{
               System.out.println("c2 y c3 son diferentes");
          }
     }
}
```

Access Control

Modifier	Same Class	Same Package	Subclass	Universe
`private`	Yes			
default	Yes	Yes		
`protected`	Yes	Yes	Yes	
`public`	Yes	Yes	Yes	Yes

The `Object` Class

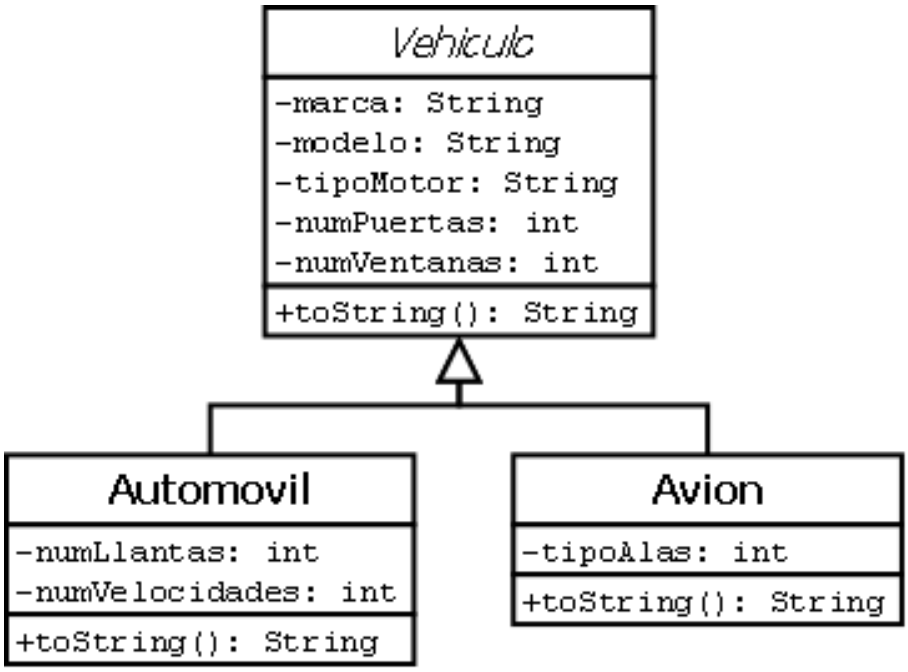
- The `Object` class is the root of all classes in Java
- A class declaration with no `extends` clause, implicitly uses "extends the Object"

```
public class Employee {
  ...
}
```

is equivalent to:

```
public class Employee extends Object {
  ...
}
```

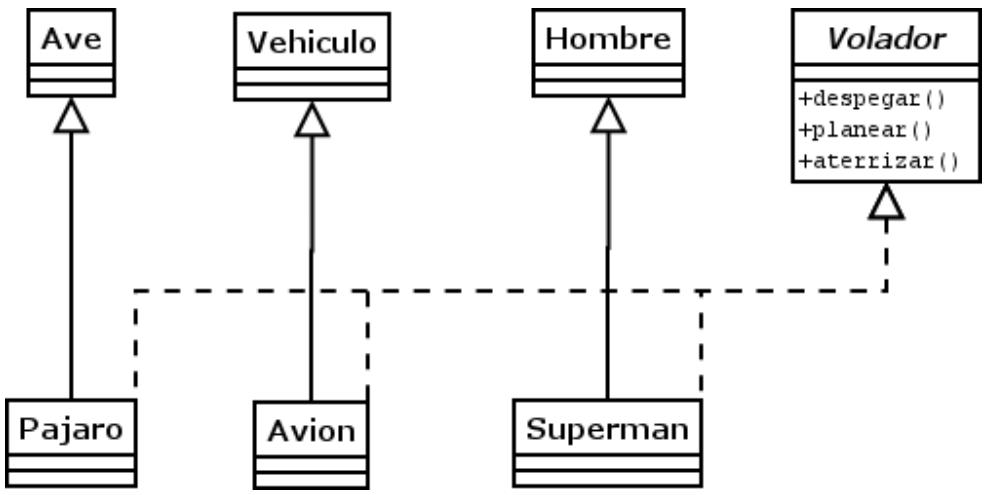
Clase Abstracta



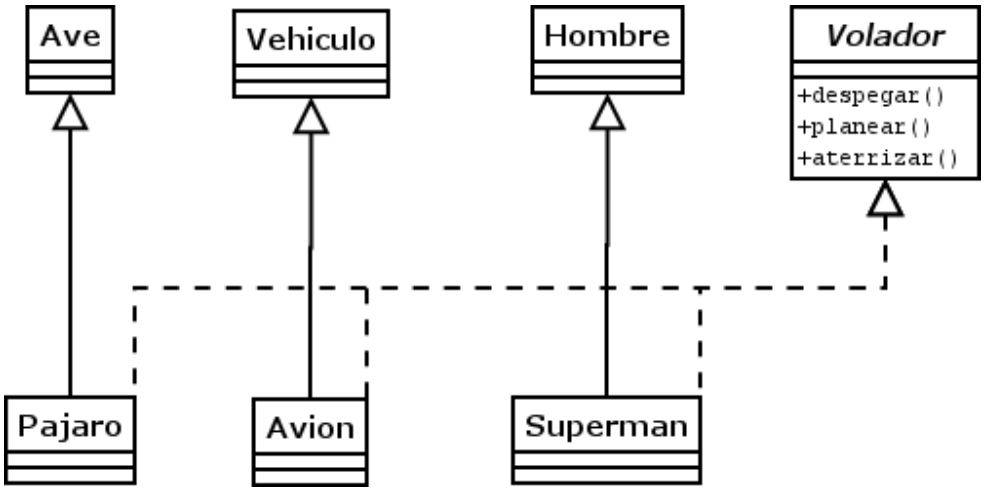

```
public class ClaseAbstracta {

     public static void main(String[] args) {
          //Vehiculo v=new Vehiculo();  //no compila
          Automovil auto=new Automovil("Ford","Mustang","Chido",2,4,4,6);
          Avion avi=new Avion("USAF","F-14","Unico",1,1,2);
          System.out.println(auto);
          System.out.println(avi);
     }
}

abstract class Vehiculo{
     private String marca;
     private String modelo;
     private String tipoMotor;
     private int numPuertas;
     private int numVentanas;

     public Vehiculo(String marcax,String modelox,String tipoMotorx,
               int numPuertasx,int numVentanasx){
          marca=marcax;
          modelo=modelox;
          tipoMotor=tipoMotorx;
          numPuertas=numPuertasx;
          numVentanas=numVentanasx;
     }

     public String toString(){  //sobreescritura de Object.toString()
          return marca+" "+modelo+" con motor "+tipoMotor+" con "+
               numPuertas+" puerta(s) y "+numVentanas+" ventana(s)";
     }
}
```

```
class Automovil extends Vehiculo{
     private int numLlantas;
     private int numVelocidades;

     public Automovil(String marcax,String modelox,String tipoMotorx,
               int numPuertasx,int numVentanasx,int numLlantasx,int
numVelocidadesx){
          super(marcax,modelox,tipoMotorx,numPuertasx,numVentanasx);
          numLlantas=numLlantasx;
          numVelocidades=numVelocidadesx;
     }

     public String toString(){  //sobreescritura de Vehiculo.toString()
          return super.toString()+" y además "+numLlantas+" llantas y "+
               numVelocidades+" velocidades";
     }
}

class Avion extends Vehiculo{
     private int tipoAlas;

     public Avion(String marcax,String modelox,String tipoMotorx,
               int numPuertasx,int numVentanasx,int tipoAlasx){
          super(marcax,modelox,tipoMotorx,numPuertasx,numVentanasx);
          tipoAlas=tipoAlasx;
     }

     public String toString(){  //sobreescritura de Vehiculo.toString()
          return super.toString()+" y además alas tipo "+tipoAlas;
     }
}
```

Herencia Múltiple



Expresiones del Polimorfismo



1.6.1 Definición del Polimorfismo

- Polimorfismo es la habilidad de tener muchas formas diferentes; por ejemplo la clase Encargado tiene acceso a los métodos de la clase Empleado
- Un objeto tiene únicamente una forma
- Una variable de instancia puede referenciar a objetos de diferentes formas

```
Empleado e1=new Empleado();
Empleado e2=new Encargado();
Empleado e3=new Ingeniero();
```

- Si una variable de instancia es de tipo Empleado, solo le son válidos de invocar los atributos y métodos (públicos) de la clase Empleado, aunque el objeto instanciado fuese por ejemplo de tipo Ingeniero

```
Employee employee = new Manager(); //legal

// Illegal attempt to assign Manager attribute
employee.department = "Sales";
// the variable is declared as an Employee type,
// even though the Manager object has that attribute
```

- Virtual method invocation:

```
Employee e = new Manager();
e.getDetails();
```

- Compile-time type and runtime type

Rules About Overridden Methods

- Must have a return type that is identical to the method it overrides
- Cannot be less accessible than the method it overrides

Algo que no funcionaría…

```
public class Parent {
  public void doSomething() {}
}

public class Child extends Parent {
  private void doSomething() {}
}

public class UseBoth {
  public void doOtherThing() {
    Parent p1 = new Parent();
    Parent p2 = new Child();
    p1.doSomething();
    p2.doSomething();
  }
}
```

Polymorphic Arguments

- Because a `Manager` is an `Employee`:

```
// In the Employee class
public TaxRate findTaxRate(Employee e) {
}
// Meanwhile, elsewhere in the application class
Manager m = new Manager();
:
TaxRate t = findTaxRate(m);
```

The instanceof Operator

```
public class Employee extends Object
public class Manager extends Employee
public class Engineer extends Employee
---------------------------------------

public void doSomething(Employee e) {
  if (e instanceof Manager) {
    // Process a Manager
  } else if (e instanceof Engineer) {
    // Process an Engineer
  } else {
    // Process any other type of Employee
  }
}
```

Sobrecarga de métodos

```
public class SobreCarga1 {
     public void imprimeBits(byte b){
          byte test=(byte)0x80;
          System.out.print(b+"=");
          for(int i=0;i<8;i++){
               if ((b&test)!=0){
                    System.out.print("1");
               }
               else{
                    System.out.print("0");
               }
               test=(byte)((test>>1)&0x7F);
          }
          System.out.println("");
     }
     public void imprimeBits(short s){
          short test=(short)0x8000;
          System.out.print(s+"=");
          for(int i=0;i<16;i++){
               if ((s&test)!=0){
                    System.out.print("1");
               }
               else{
                    System.out.print("0");
               }
               test=(short)((test>>1)&0x7FFF);
          }
          System.out.println("");
     }
     public static void main(String[] args) {
          SobreCarga1 sc=new SobreCarga1();
          byte b1;
          short s1;
          int limitePositivo=16,limiteNegativo=-112;
          System.out.println("Positivos byte");
          for(b1=0;b1<limitePositivo;b1++){
               sc.imprimeBits(b1);
          }
          System.out.println("Negativos byte");
          for(b1=-128;b1<limiteNegativo;b1++){
               sc.imprimeBits(b1);
          }
          System.out.println("Positivos short");
          for(s1=0;s1<limitePositivo;s1++){
               sc.imprimeBits(s1);
          }
          System.out.println("Negativos short");
          for(s1=-128;s1<limiteNegativo;s1++){
               sc.imprimeBits(s1);
          }
     }
}
```

Otro ejemplo:

```
public class SobreCarga2 {

     public static void main(String[] args) {
          Empleado e=new Empleado();
          System.out.println(e.dameInfo());
          System.out.println("- - -");
          e.fijaInfo("Luis");
          System.out.println(e.dameInfo());
          System.out.println("- - -");
          e.fijaInfo("Alberto",1000);
          System.out.println(e.dameInfo());
          System.out.println("- - -");
          e.fijaInfo("Luis Alberto",4400,new MiFecha(1979,9,12));
          System.out.println(e.dameInfo());
     }

}

class Empleado{
     private String nombre;
     private double salario;
     private MiFecha fechaNacimiento;

     public Empleado(){
          nombre="staff";
          salario=0;
          fechaNacimiento=new MiFecha(2007,8,1);
     }

     public void fijaInfo(String nombrex){
          nombre=nombrex;
     }

     public void fijaInfo(String nombrex,double salariox){
          fijaInfo(nombrex);
          salario=salariox;
     }

     public void fijaInfo(String nombrex,double salariox,
          MiFecha fechaNacimientox){
          fijaInfo(nombrex,salariox);
          fechaNacimiento=fechaNacimientox;
     }

     public String dameInfo(){
          String info="Nombre: "+nombre+"\n"+
                         "Salario: "+salario+"\n"+
                         "Fecha Nacimiento: "+fechaNacimiento;
          return info;
     }
}
```

Overloading Method Names

- Use as follows:

```
public void println(int i)
public void println(float f)
public void println(String s)
```

- Argument lists *must* differ.
- Return types *can* be different.

Overloading Constructors

- As with methods, constructors can be overloaded.
- Example:

```
public Employee(String name, double salary, Date DoB)
public Employee(String name, double salary)
public Employee(String name, Date DoB)
```

- Argument lists *must* differ.
- You can use the `this` reference at the first line of a constructor to call another constructor.

```
1   public class Employee {
2     private static final double BASE_SALARY = 15000.00;
3     private String name;
4     private double salary;
5     private Date   birthDate;
6
7     public Employee(String name, double salary, Date DoB) {
8       this.name = name;
9       this.salary = salary;
10      this.birthDate = DoB;
11    }
12    public Employee(String name, double salary) {
13      this(name, salary, null);
14    }
15    public Employee(String name, Date DoB) {
16      this(name, BASE_SALARY, DoB);
17    }
18    public Employee(String name) {
19      this(name, BASE_SALARY);
20    }
21    // more Employee code...
22  }
```

Constructors Are Not Inherited

- A subclass inherits all methods and variables from the superclass (parent class).
- A subclass does not inherit the constructor from the superclass.
- Two ways to include a constructor are:
  - Use the default constructor
  - Write one or more explicit constructors

Invoking Parent Class Constructors

- To invoke a parent constructor, you must place a call to `super` in the first line of the constructor
- You can call a specific parent constructor by the arguments that you use in the call to `super`
- If no `this` or `super` call is used in a constructor, then the compiler adds an implicit call to `super()` that calls the parent no argument constructor (which could be the "default" constructor)
  - If the parent class defines constructors, but does not provide a no argument constructor, then a compiler error message is issued

```
1   public class Employee {
2     private static final double BASE_SALARY = 15000.00;
3     private String name;
4     private double salary;
5     private Date   birthDate;
6
7     public Employee(String name, double salary, Date DoB) {
8       this.name = name;
9       this.salary = salary;
10      this.birthDate = DoB;
11    }
12    public Employee(String name, double salary) {
13      this(name, salary, null);
14    }
15    public Employee(String name, Date DoB) {
16      this(name, BASE_SALARY, DoB);
17    }
18    public Employee(String name) {
19      this(name, BASE_SALARY);
20    }
21    // more Employee code...
22  }
```

```
1   public class Manager extends Employee {
2     private String department;
3
4     public Manager(String name, double salary, String dept) {
5       super(name, salary);
6       department = dept;
7     }
8     public Manager(String n, String dept) {
9       super(name);
10      department = dept;
11    }
12    public Manager(String dept) { // This code fails: no super()
13      department = dept;
14    }
15  }
```

Sobre-escritura de métodos

```
public class Employee {
  protected String name;
  protected double salary;
  protected Date birthDate;

  public String getDetails() {
    return "Name: " + name + "\n" +
           "Salary: " + salary;
  }
}


public class Manager extends Employee {
  protected String department;

  public String getDetails() {
    return "Name: " + name + "\n" +
           "Salary: " + salary + "\n" +
           "Manager of: " + department;
  }
}
```

o bien usando la palabra clave *super* …

```
public class Manager extends Employee {
  private String department;

  public String getDetails() {
    // call parent method
    return super.getDetails() +
           "\nDepartment: " + department;
  }
}
```

Método Abstracto

```
1  public abstract class Vehicle {
2    public abstract double calcFuelEfficiency();
3    public abstract double calcTripDistance();
4  }
```

```
1  public class Truck extends Vehicle {
2    public Truck(double max_load) {...}
3
4    public double calcFuelEfficiency() {
5      /* calculate the fuel consumption of a truck at a given load */
6    }
7    public double calcTripDistrance() {
8      /* calculate the distance of this trip on highway */
9    }
10 }
```

```
1  public class RiverBarge extends Vehicle {
2    public RiverBarge(double max_load) {...}
3
4    public double calcFuelEfficiency() {
5      /* calculate the fuel efficiency of a river barge */
6    }
7    public double calcTripDistrance() {
8      /* calculate the distance of this trip along the river-ways */
9    }
10 }
```

Casting Objects

- Use `instanceof` to test the type of an object
- Restore full functionality of an object by casting
- Check for proper casting using the following guidelines:
  - Casts up hierarchy are done implicitly.
  - Downward casts must be to a subclass and checked by the compiler.
  - The object type is checked at runtime when runtime errors can occur.

Retomando las clases Empleado e Ingeniero (tema 1.5.1)…

```
Empleado e1=new Empleado();      //bien
Ingeniero ing=new Ingeniero();   //bien
Empleado e2=new Ingeniero();     //bien
e1.nombre=”Luis”;                //bien
ing.especialidad=”Software”;     //bien
e2.nombre=”Luis Alberto”;        //bien
e2.especialidad=”Hardware”;      /*no compila ya que especialidad
                                   no es atributo de Empleado*/
((Ingeniero)e2).especialidad=”Software de Sistemas”;   //esta sí compila
((Ingeniero)e1).especialidad=”Sistemas Digitales”;     /*también compila
                                        pero truena en tiempo de ejecución*/
```

Heterogeneous Collections

- Collections of objects with the same class type are called *homogenous* collections.

```
MyDate[]  dates = new MyDate[2];
dates[0] = new MyDate(22, 12, 1964);
dates[1] = new MyDate(22, 7, 1964);
```

- Collections of objects with different class types are called *heterogeneous* collections.

```
Employee [] staff = new Employee[1024];
staff[0] = new Manager();
staff[1] = new Employee();
staff[2] = new Engineer();
```

```
A a=new A();  //suponiendo que A tiene el método andar()
B b=new B();  //suponiendo que B hereda de A
C c=new C();  //suponiendo que C hereda de A
a.andar();
b.andar();
c.andar();
```

```
A[] andadores=new A[3];
andadores[0]=new A();
andadores[1]=new B();
andadores[2]=new C();
for(i=0;i<andadores.length;i++){
   andadores[i].andar();
}
```

```
public class ColeccionesHeterogeneas {

     public static void main(String[] args) {
          Empleado emp=new Empleado("Luis",9000,new MiFecha(1980,2,1));
          Secretario sec=new Secretario("Alberto",5000,
              new MiFecha(1981,3,2),"7-15hrs.");
          Ingeniero ing=new Ingeniero("Luis Alberto",15000,
              new MiFecha(1979,9,12),"Software de Sistemas");
          Encargado jefe=new Encargado("LA",20000,new MiFecha(1979,9,16),
              "Computación");
          Empleado empleados[]=new Empleado[4];
          empleados[0]=emp;
          empleados[1]=sec;
          empleados[2]=ing;
          empleados[3]=jefe;
          for(int i=0;i<empleados.length;i++){
               System.out.println(empleados[i].dameInfo());
          }
     }
}
```

Almacenamiento de objetos en arreglos dinámicos

```
import java.util.Vector;

public class ArreglosDinamicos {

     public static void imprimeVector(Vector v){
          String s;
          for(int i=0;i<v.size();i++){
               s=(String)v.get(i);
               System.out.println(s);
          }
          System.out.println("- - - - - - - - - -");
     }

     public static void main(String[] args) {
          Vector v=new Vector();
          String s="Taller ";
          v.add(s);
          s="de ";
          v.add(s);
          s="Programación ";
          v.add(s);
          s="Orientada ";
          v.add(s);
          s="a ";
          v.add(s);
          s="Objetos ";
          v.add(s);
          ArreglosDinamicos.imprimeVector(v);
          v.remove(1);
          ArreglosDinamicos.imprimeVector(v);
          v.remove(3);
          ArreglosDinamicos.imprimeVector(v);
     }

}
```

The == Operator Compared With the `equals` Method

- The == operator determines if two references are identical to each other (that is, refer to the same object).
- The `equals` method determines if objects are "equal" but not necessarily identical.
- The `Object` implementation of the `equals` method uses the == operator.
- User classes can override the `equals` method to implement a domain-specific test for equality.
- Note: You should override the `hashCode` method if you override the `equals` method.

```
1  public class MyDate {
2    private int day;
3    private int month;
4    private int year;
5
6    public MyDate(int day, int month, int year) {
7      this.day   = day;
8      this.month = month;
9      this.year  = year;
10   }
11
12   public boolean equals(Object o) {
13     boolean result = false;
14     if ( (o != null) && (o instanceof MyDate) ) {
15       MyDate d = (MyDate) o;
16       if ( (day == d.day) && (month == d.month)
17       && (year == d.year) ) {
18         result = true;
19       }
20     }
21     return result;
22   }
23
24   public int hashCode() {
25     return (day ^ month ^ year);
26   }
27 }
```

//la edición 2002 del SL-275 tiene esto, funciona así con atributos prívate?

Wrapper Classes

- Look at primitive data elements as objects

Primitive Data Type	Wrapper Class
boolean	Boolean
byte	Byte
char	Character
short	Short
int	Integer
long	Long
float	Float
double	Double

```
int pInt = 500;
Integer wInt = new Integer(pInt);
int p2 = wInt.intValue();
```

```
Interno de Integer.toString()

int a=10;
char[] c=new char[2]
c[0]=//codigo ascii del "1"
c[1]=//codigo ascii del "0"
System.out.println(""+a);
```

Notas de clase:

//acerca de la representación de datos y objetos en la memoria

Memoria	0	0	0	10	0	0	1	0	0	0	78	44	#	#	#	#	#	#	#	#	…	#	0	0	78	44
Dirección	20000	20001	20002	20003	20004	20005	20006	20007	20008	20009	20010	20011	20012	20013	20014	20015	20016	20017	20018	20019	20020	21500	20501	20502	20503	20504
Variable u objeto	a (10)				b (256)				inge (20012)				(instancia de Ingeniero)										maestro (20012)			

```
int a=10,b=256;
Ingeniero inge=new Ingeniero();
Ingeniero maestro=inge;
Ingeniero otroInge=new Ingeniero();

if (inge==maestro){  //comparación de direcciones de memoria
  //somos el mismo objeto
}
else{
  //somos distintos objetos,
}
if (inge==otroInge){  //comparación de direcciones de memoria
  //somos el mismo objeto
}
else{
  //somos distintos objetos,
}
```

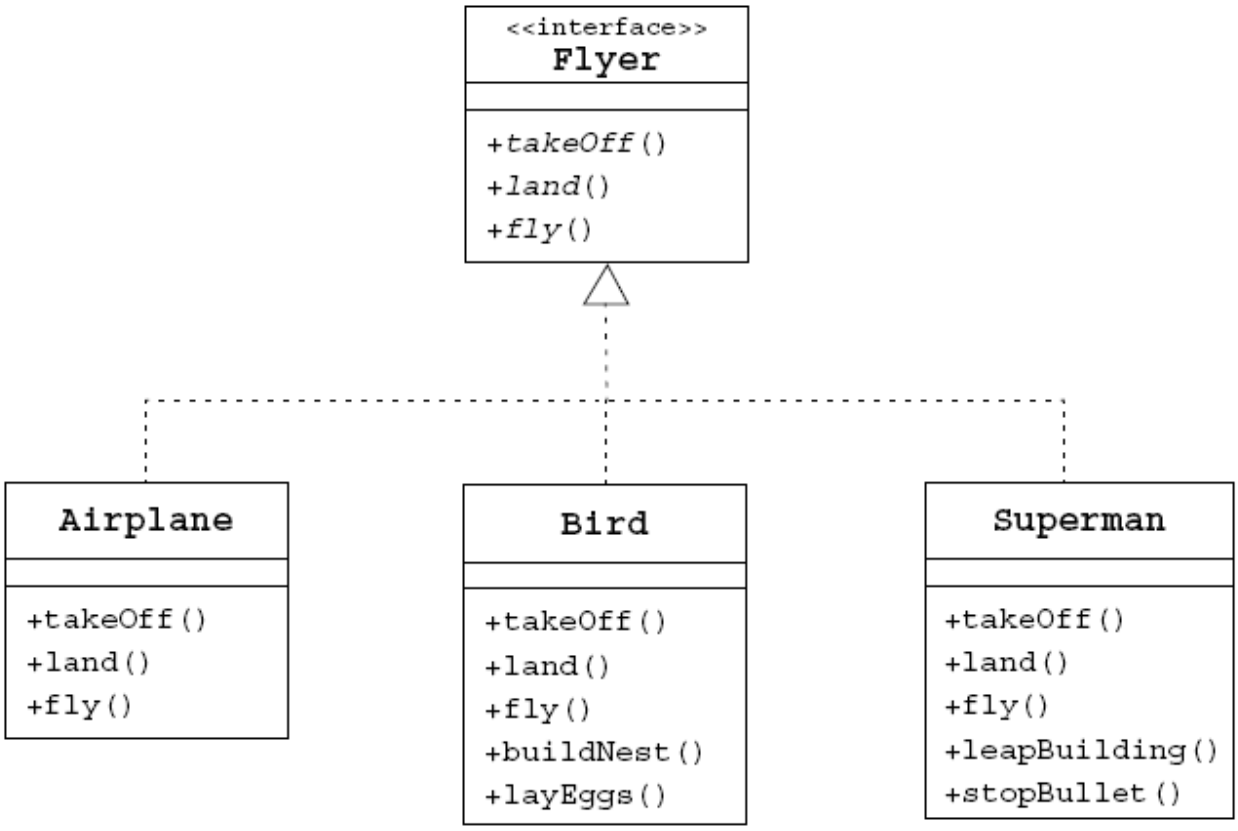
Clase Administradora

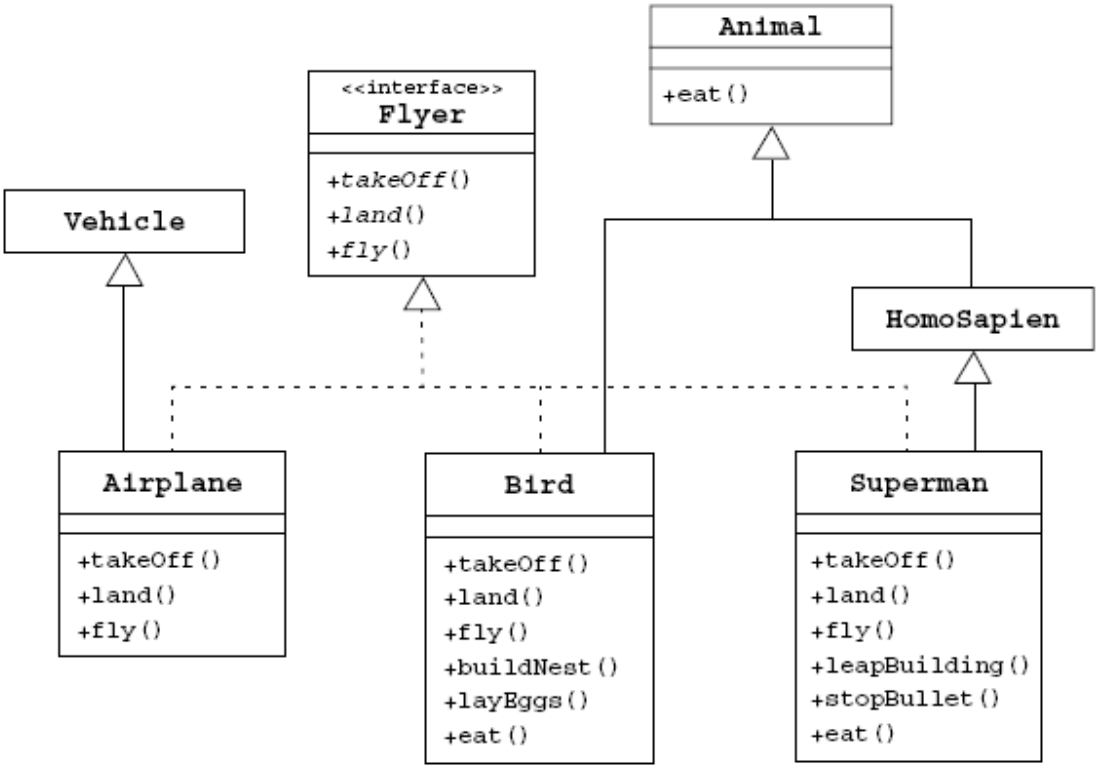
```
public class UsaVector {
    public static void main(String[] args) {
        ClaseAdministradora admin=new ClaseAdministradora();
        Materia m;
        admin.alta("CC200","Programación Orientada a Objetos");
        admin.alta("CC201","Taller de POO");
        m=admin.consulta(1);  //asumo que existe
        System.out.println(m.dameInfo());
        System.out.println(m);
        System.out.println("registro:"+m);
        admin.alta("CC202","Estructuras de Datos");
        admin.alta("CC203","Taller de Estructuras de Datos");
        System.out.println(admin.dameInfo());
        if (admin.baja("CC202")){
            System.out.println(admin.dameInfo());
        }
        else{
            System.out.println("No se pudo eliminar");
        }
    }
}
class Materia{
    public String clave;
    public String nombre;
    /*aquí constructor*/
    //este método ya se explicó como funciona
    public String dameInfo(){
        String s;
        s=clave+"\t"+nombre;
        return s;
    }
    //y que tal si se sobreescribiera de Object?
    public String toString(){
        String s;
        s=clave+"\t"+nombre;
        return s;
    }
}
```

```
class ClaseAdministradora{
    private Vector lista;
    /*un constructor inicializaría lista*/
    public void alta(String clave,String nombre){
        Materia m;
        m=new Materia(clave,nombre);
        lista.add(m);
        /* se podría usar
         * lista.add(posicion,m);
         * para dar de alta en orden por clave
         */
    }  //el método podría regresar boolean
    /* se podría implementar un método:
     * public void alta(String clave,String nombre,int posicion)
     */
    public Materia consulta(int posicion){
        Materia m;
        if (posicion<lista.size()){
            m=(Materia)lista.get(posicion);
        }
        else{
            m=null;
        }
        return m;
    }
    /*podría implementarse un método:
     * public Materia consulta(String clave);
     */
    public boolean baja(String clave){
        boolean encontro=false;  //hay casos así
        int i,j;
        Materia m;
        for(i=0,j=lista.size();i<j;i++){
            m=(Materia)lista.get(i);
            if (m.clave.equals(clave)){
                lista.remove(i);
                encontro=true;
                break;
            }
            else{
                //seguir buscando
            }
        }
        return encontro;
    }
```

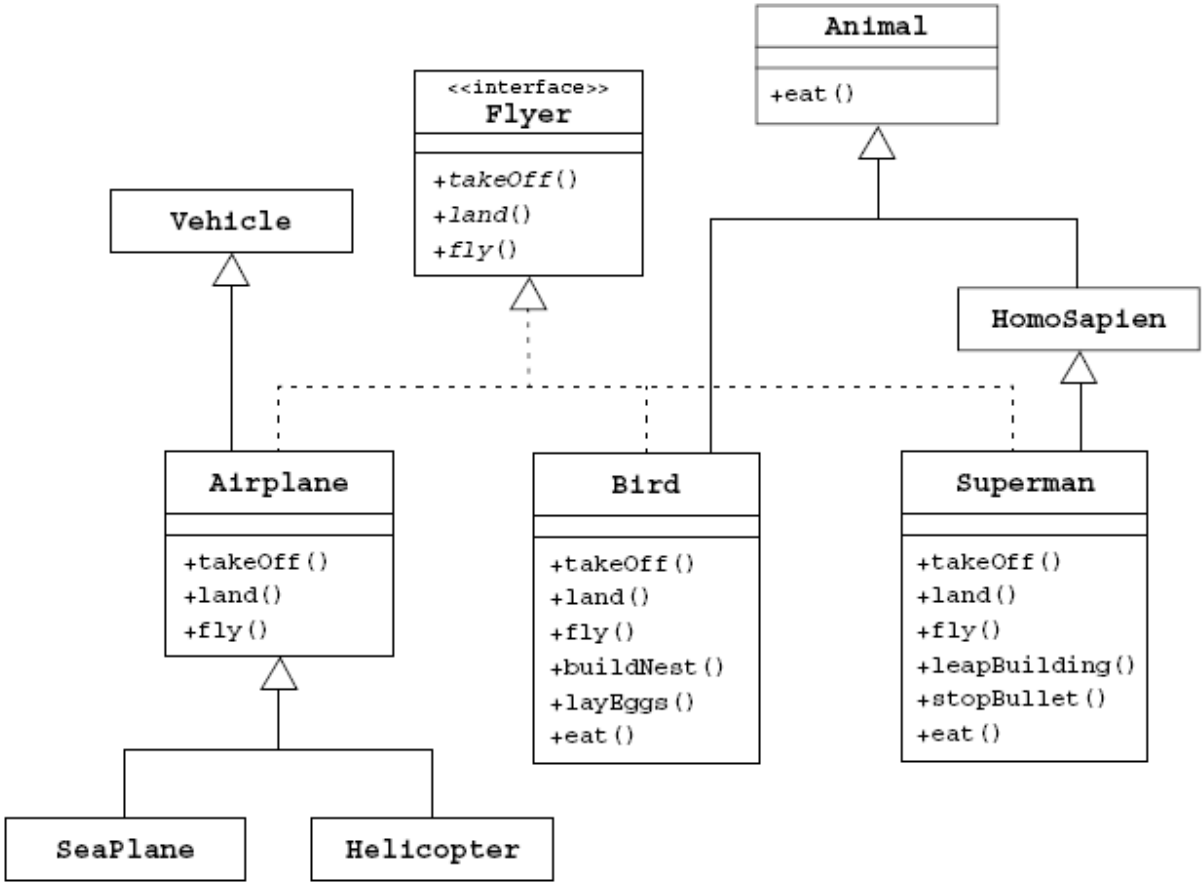
```
    /* podría implementarse un método:
     * public boolean baja(int posicion);
     */
    public String dameInfo(){
        String s="";
        Materia m;
        int i,j;
        for(i=0,j=lista.size();i<j;i++){
            m=(Materia)lista.get(i);
            s+=m.dameInfo()+"\n";
            // y que tal? si...
            //s+=m+"\n";
            //funciona igual?
        }
        return s;
    }
    //sería bueno sin dameInfo() y sobreescribir toString()?
}
```

Uso de interfaces





```
public class Bird extends Animal implements Flyer {
  public void takeOff()    { /* take-off implementation  */ }
  public void land()       { /* landing implementation   */ }
  public void fly()        { /* fly implementation       */ }
  public void buildNest()  { /* nest building behavior   */ }
  public void layEggs()    { /* egg laying behavior      */ }
  public void eat()        { /* override eating behavior */ }
}
```



```
public class Airport {
  public static void main(String[] args) {
    Airport metropolisAirport = new Airport();
    Helicopter copter = new Helicopter();
    SeaPlane sPlane = new SeaPlane();
    Flyer S = Superman.getSuperman(); // Superman is a Singleton

    metropolisAirport.givePermissionToLand(copter);
    metropolisAirport.givePermissionToLand(sPlane);
    metropolisAirport.givePermissionToLand(S);
  }

  private void givePermissionToLand(Flyer f) {
    f.land();
  }
}
```

Múltiples interfaces