PHP Classes and Objects

Chapter 10

Randy Connolly and Ricardo Hoar

Fundamentals of Web Development

Objectives

1 Object-Oriented Overview

2 Classes and Objects in PHP

3 Object Oriented Design

Section 1 of 3

OBJECT-ORIENTED OVERVIEW

Overview

Object-Oriented Overview

PHP is a full-fledged object-oriented language with many of the syntactic constructs popularized in languages like Java and C++.

Earlier versions of PHP do not support all of these object-oriented features,

- PHP versions after 5.0 do

Terminology

Object-Oriented Terminology

The notion of programming with objects allows the developer to think about an item with particular **properties** (also called attributes or **data members**) and methods (functions).

The structure of these **objects** is defined by **classes**, which outline the properties and methods like a blueprint.

Each variable created from a class is called an object or **instance**, and each object maintains its own set of variables, and behaves (largely) independently from the class once created.

UML

The Unified Modelling Language

The standard diagramming notation for object-oriented design is **UML (Unified Modeling Language).**

Class diagrams and object diagrams, in particular, are useful to us when describing the properties, methods, and relationships between classes and objects.

For a complete definition of UML modeling syntax, look at the Object Modeling Group's living specification

UML Class diagram

By example

Every Artist has a

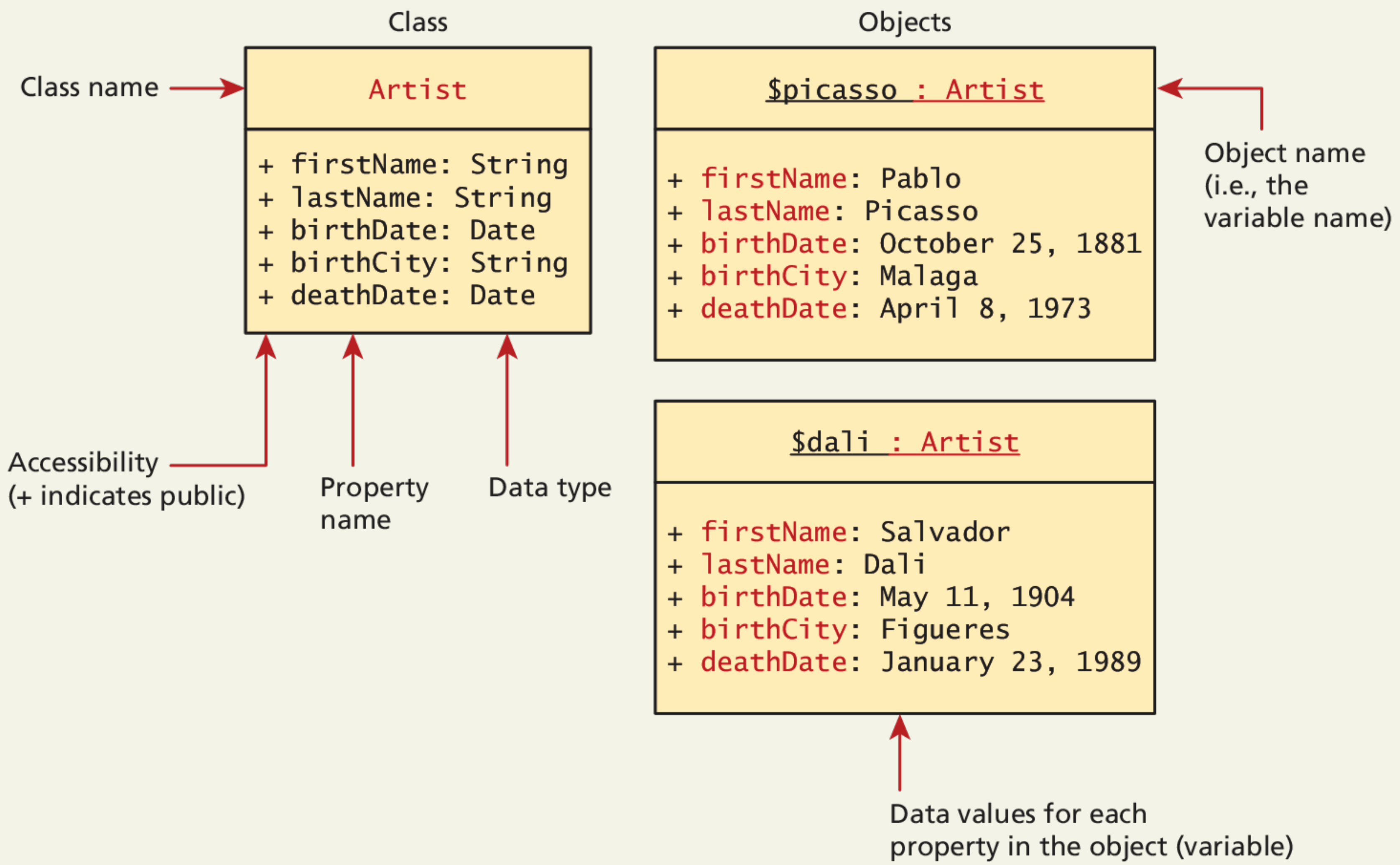
- first name,
- last name,
- birth date,
- birth city, and
- death date.

Using objects we can encapsulate those properties together into a class definition for an Artist.

UML articulates that design

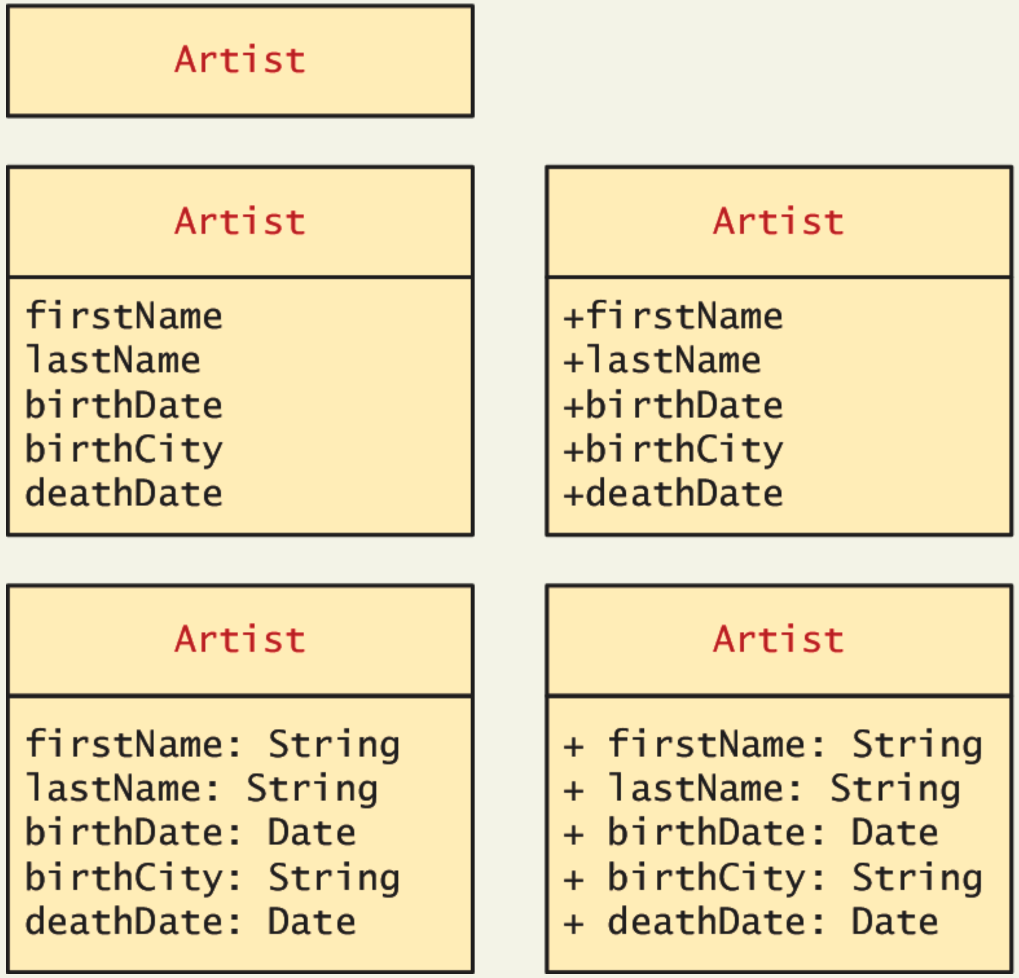
UML Class diagram

Class and a couple of objects



UML Class diagram

Different levels of detail



Server and Desktop Objects

Not the same

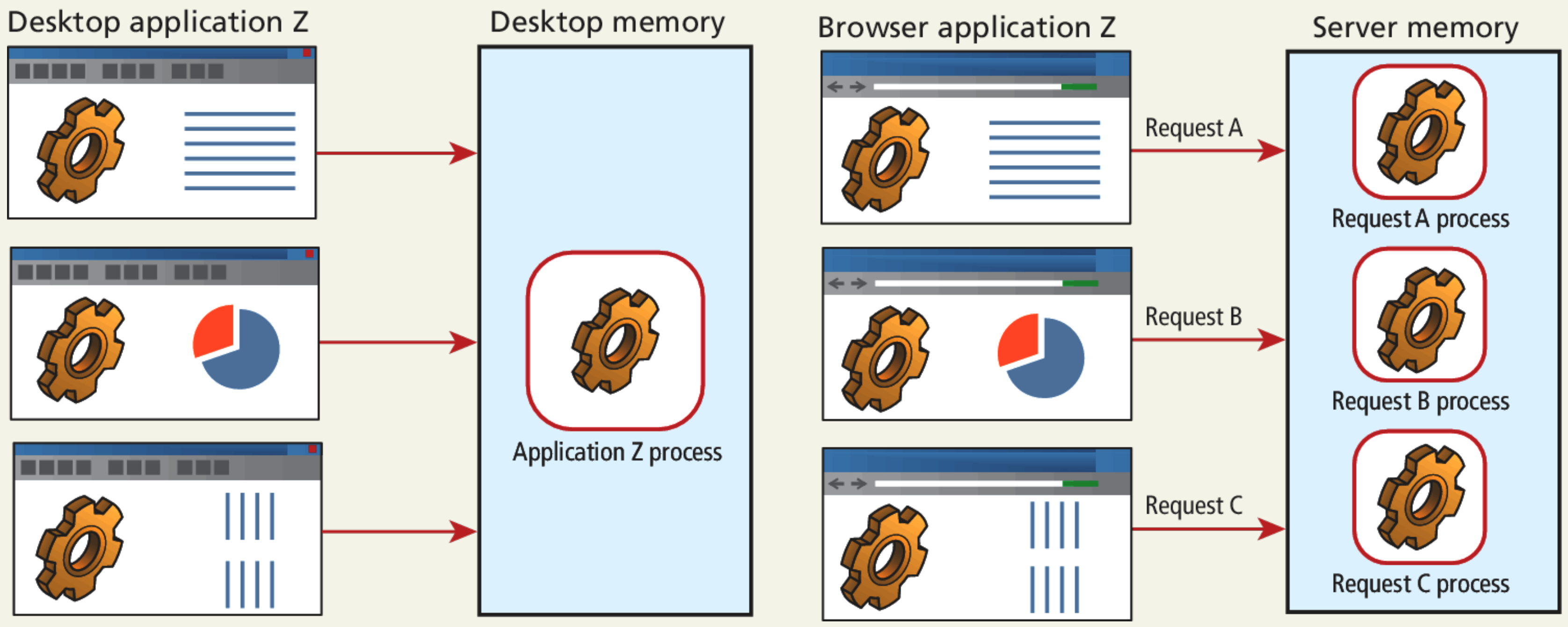
While desktop software can load an object into memory and make use of it for several user interactions, a PHP object is loaded into memory only for the life of that HTTP request.

We must use classes differently than in the desktop world, since the object must be recreated and loaded into memory

Unlike a desktop, there are potentially many thousands of users making requests at once, so not only are objects destroyed upon responding to each request, but memory must be shared between many simultaneous requests, each of which may load objects into memory

Server and Desktop Objects

Not the same



Section 2 of 3

OBJECTS AND CLASSES IN PHP

Defining Classes

In PHP

The PHP syntax for defining a class uses the **class** keyword followed by the class **name** and **{ }** braces

```
class Artist {
   public   $firstName;
   public   $lastName;
   public   $birthDate;
   public   $birthCity;
   public   $deathDate;
}
```

LISTING 10.1 A simple Artist class

Instantiating Objects

In PHP

Defining a class is not the same as using it. To make use of a class, one must **instantiate** (create) objects from its definition using the *new* keyword.

```
$picasso = new Artist();

$dali = new Artist();
```

Properties

The things in the objects

Once you have instances of an object, you can access and modify the properties of each one separately using the variable name and an arrow (**->**).

```php
$picasso = new Artist();
$dali = new Artist();
$picasso->firstName = "Pablo";
$picasso->lastName = "Picasso";
$picasso->birthCity = "Malaga";
$picasso->birthDate = "October 25 1881";
$picasso->deathDate = "April 8 1973";
```

LISTING 10.2 Instantiating two Artist objects and setting one of those object's properties

Constructors

A Better way to build

Constructors let you specify parameters during instantiation to initialize the properties within a class right away.

In PHP, constructors are defined as functions (as you shall see, all methods use the function keyword) with the name **__construct()**

Notice that in the constructor each parameter is assigned to an internal class variable using the **$this->** syntax.

You **must** always use the **$this** syntax to reference all properties and methods associated with this particular instance of a class.

Constructors

An Example

```
class Artist {
   // variables from previous listing still go here
   ...

   function __construct($firstName, $lastName, $city, $birth,
                         $death=null) {
      $this->firstName = $firstName;
      $this->lastName = $lastName;
      $this->birthCity = $city;
      $this->birthDate = $birth;
      $this->deathDate = $death;
   }
}
```

LISTING 10.3 A constructor added to the class definition

Constructors

Using the constructor

```
$picasso = new Artist("Pablo","Picasso","Malaga","Oct 25,1881","Apr 8,1973");

$dali = new Artist("Salvador","Dali","Figures","May 11 1904", "Jan 23 1989");
```

Methods

Functions In a class

Methods and are like functions, except they are associated with a class.

They define the tasks each instance of a class can perform and are useful since they associate behavior with objects.

```
$picasso = new Artist( . . . )

echo $picasso->outputAsTable();
```

Methods

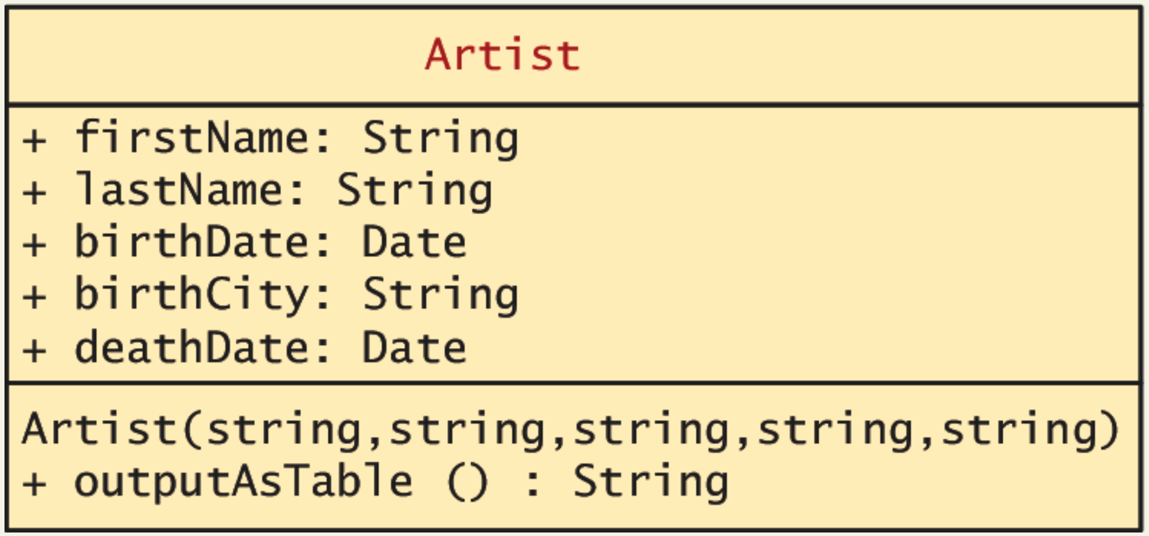
The example definition

```
class Artist {
   . . .
   public function outputAsTable() {
     $table = "<table>";
     $table .= "<tr><th colspan='2'>";
     $table .= $this->firstName . " " . $this->lastName;
     $table .= "</th></tr>";
     $table .= "<tr><td>Birth:</td>";
     $table .= "<td>" . $this->birthDate;
     $table .= "(" . $this->birthCity . ")</td></tr>";
     $table .= "<tr><td>Death:</td>";
     $table .= "<td>" . $this->deathDate . "</td></tr>";
     $table .= "</table>";
     return $table;
   }
}
```

LISTING 10.4 Method definition

Methods

UML class diagrams adding the method



```
Artist
+ firstName: String
+ lastName: String
+ birthDate: Date
+ birthCity: String
+ deathDate: Date
Artist(string,string,string,string,string)
+ outputAsTable () : String
```

Visibility

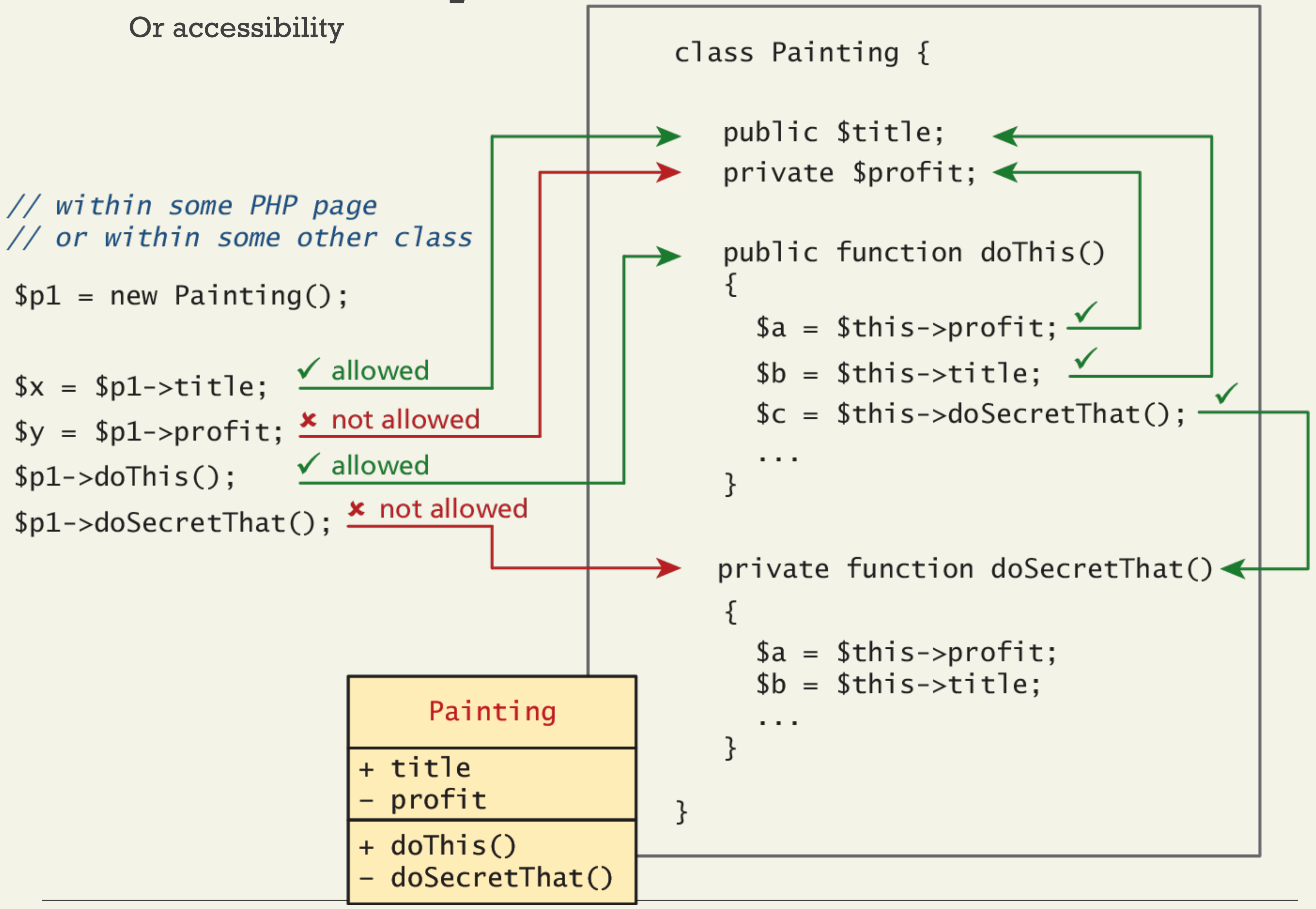
Or accessibility

The **visibility** of a property or method determines the accessibility of a **class member** and can be set to:

- **public** the property or method is accessible to any code that has a reference to the object
- **private** sets a method or variable to only be accessible from within the class
- **protected** is related to inheritance…

Visibility

Or accessibility



```
// within some PHP page
// or within some other class

$p1 = new Painting();

$x = $p1->title;        ✓ allowed
$y = $p1->profit;       ✗ not allowed
$p1->doThis();          ✓ allowed
$p1->doSecretThat();    ✗ not allowed
```

```
class Painting {

   public $title;
   private $profit;

   public function doThis()
   {
      $a = $this->profit;   ✓
      $b = $this->title;    ✓
      $c = $this->doSecretThat();   ✓
      ...
   }

   private function doSecretThat()
   {
      $a = $this->profit;
      $b = $this->title;
      ...
   }

}
```

```
Painting
+ title
- profit
+ doThis()
- doSecretThat()
```

Static Members

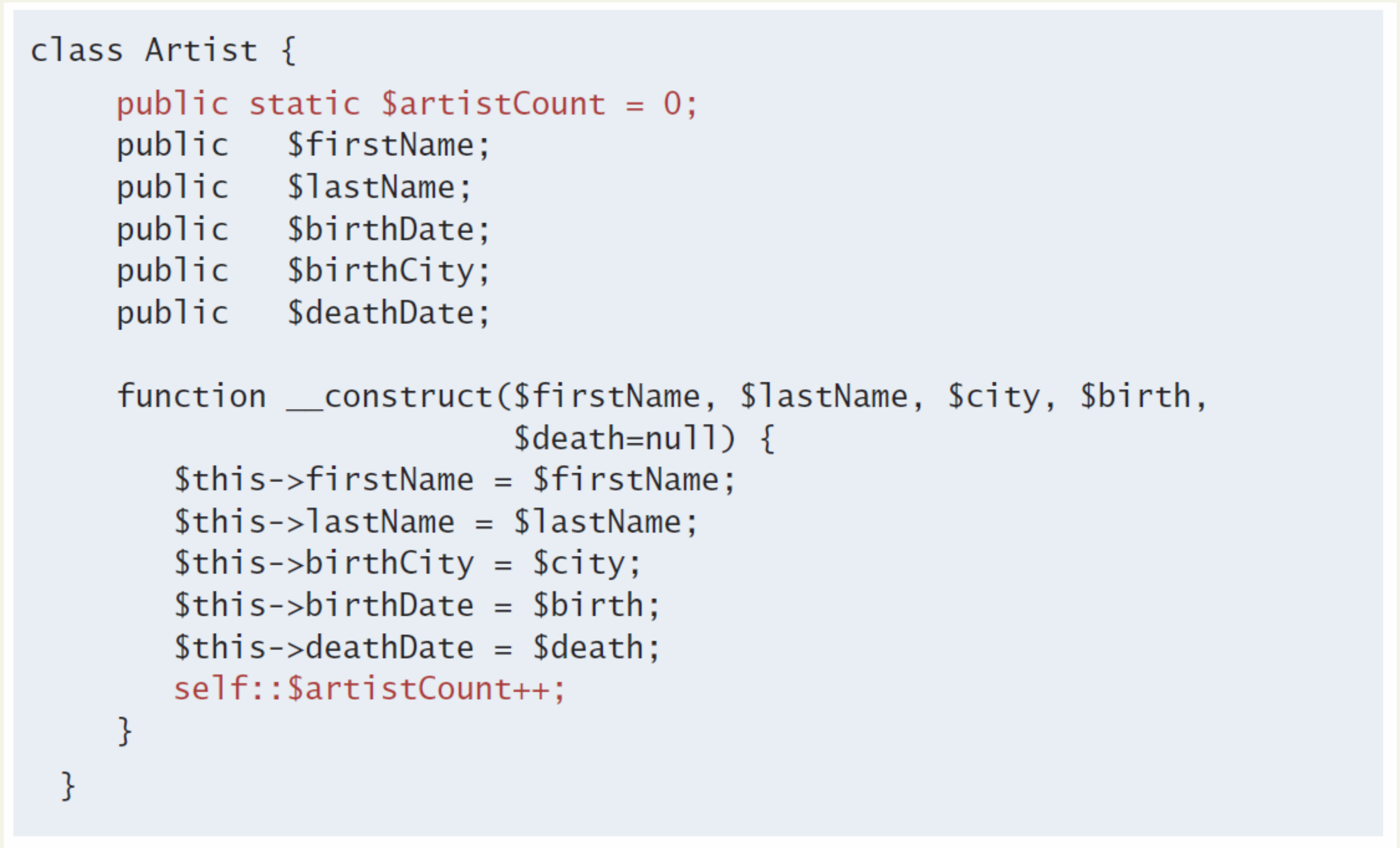
A **static** member is a property or method that all instances of a class share.

Unlike an instance property, where each object gets its own value for that property, there is only one value for a class's static property.

Static members use the **self::** syntax and are not associated with one object

They can be accessed without any instance of an Artist object by using the class name, that is, via **Artist::$artistCount**

Static Members

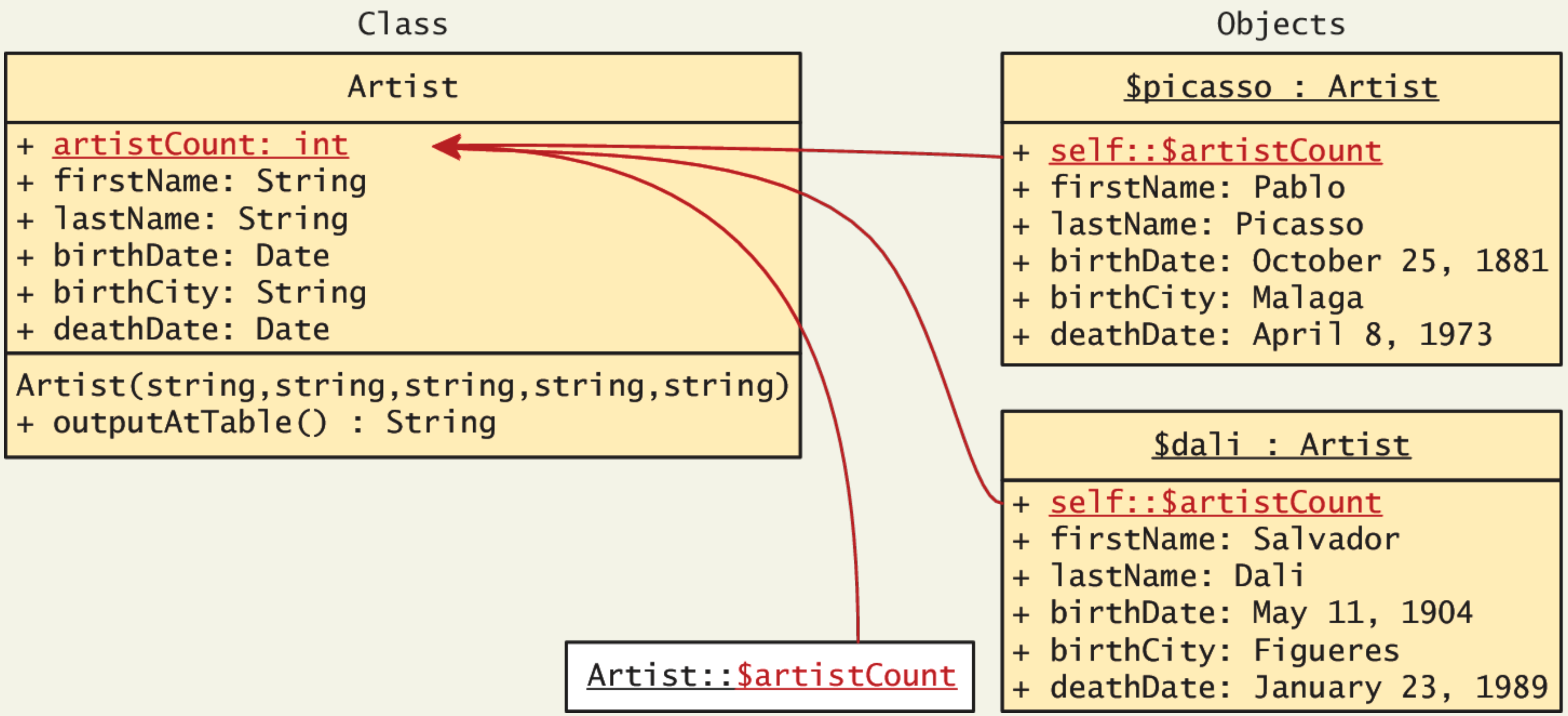


```
class Artist {
    public static $artistCount = 0;
    public   $firstName;
    public   $lastName;
    public   $birthDate;
    public   $birthCity;
    public   $deathDate;

    function __construct($firstName, $lastName, $city, $birth,
                          $death=null) {
       $this->firstName = $firstName;
       $this->lastName = $lastName;
       $this->birthCity = $city;
       $this->birthDate = $birth;
       $this->deathDate = $death;
       self::$artistCount++;
    }
 }
```

LISTING 10.5 Class definition modified with static members

Static Members

Uml again



Class constants

Never changes

Constant values can be stored more efficiently as class constants so long as they are not calculated or updated

They are added to a class using the **const** keyword.

const EARLIEST_DATE = 'January 1, 1200';

Unlike all other variables, constants don’t use the $ symbol when declaring or using them.

Accessed both inside and outside the class using

- **self::EARLIEST_DATE** in the class and
- **classReference::EARLIEST_DATE** outside.

Section 2 of 3

OBJECT ORIENTED DESIGN

Data Encapsulation

What is it?

Perhaps the most important advantage to object-oriented design is the possibility of **encapsulation**, which generally refers to restricting access to an object’s internal components.

Another way of understanding encapsulation is: it is the hiding of an object’s implementation details

A properly encapsulated class will define an interface to the world in the form of its public methods, and leave its data, that is, its properties, hidden (that is, private).

Data Encapsulation

Getters and setters

If a properly encapsulated class makes its properties private, then how do you access them?

- **getters**
- **setters**

Data Encapsulation

Getters

A getter to return a variable’s value is often very straightforward and should not modify the property.

```
public function getFirstName() {
        return $this->firstName;
}
```

Data Encapsulation

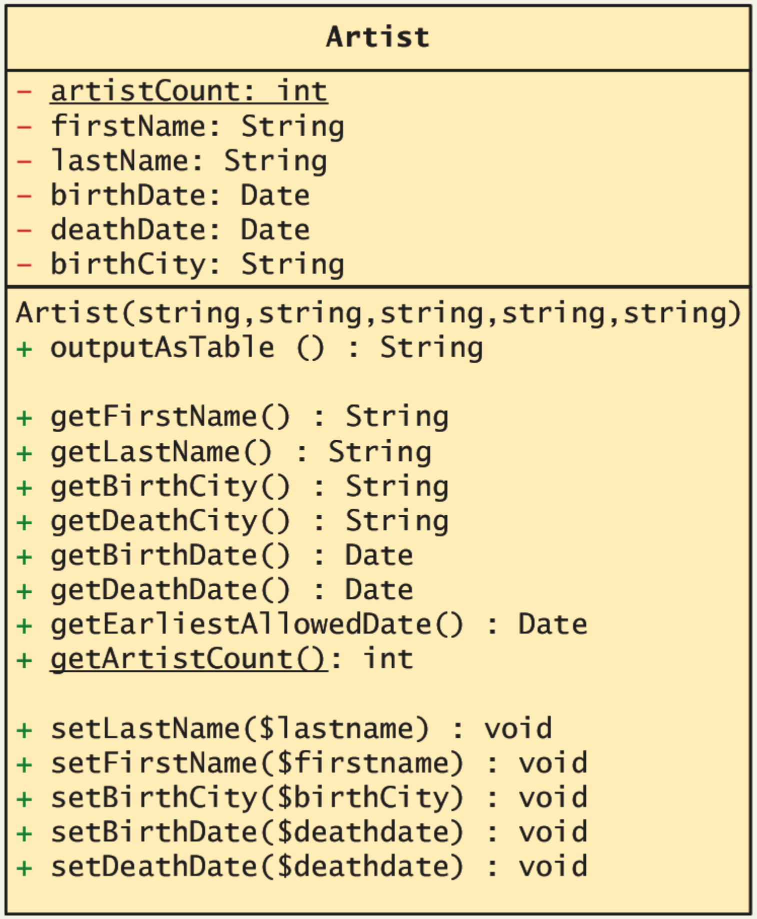
Setters

Setter methods modify properties, and allow extra logic to be added to prevent properties from being set to strange values.

```
public function setBirthDate($birthdate){
        // set variable only if passed a valid date string
        $date = date_create($birthdate);
        if ( ! $date ) {
                $this->birthDate = $this->getEarliestAllowedDate();
        }
        else {
        // if very early date then change it to
        // the earliest allowed date
                if ( $date < $this->getEarliestAllowedDate() ) {
                    $date = $this->getEarliestAllowedDate();
                }
                $this->birthDate = $date;
        }

}
```

Data Encapsulation

UML



```
Artist
- artistCount: int
- firstName: String
- lastName: String
- birthDate: Date
- deathDate: Date
- birthCity: String
Artist(string,string,string,string,string)
+ outputAsTable () : String

+ getFirstName() : String
+ getLastName() : String
+ getBirthCity() : String
+ getDeathCity() : String
+ getBirthDate() : Date
+ getDeathDate() : Date
+ getEarliestAllowedDate() : Date
+ getArtistCount(): int

+ setLastName($lastname) : void
+ setFirstName($firstname) : void
+ setBirthCity($birthCity) : void
+ setBirthDate($deathdate) : void
+ setDeathDate($deathdate) : void
```

Data Encapsulation

Using an encapsulated class

```
<html>
  <body>
  <h2>Tester for Artist class</h2>

  <?php
  // first must include the class definition
  include 'Artist.class.php';

  // now create one instance of the Artist class
  $picasso = new Artist("Pablo","Picasso","Malaga","Oct 25,1881",
                        "Apr 8,1973");

  // output some of its fields to test the getters
  echo $picasso->getLastName() . ': ';
  echo date_format($picasso->getBirthDate(),'d M Y') . ' to ';
  echo date_format($picasso->getDeathDate(),'d M Y') . '<hr>';

  // create another instance and test it
  $dali = new Artist("Salvador","Dali","Figures","May 11,1904",
                     "January 23,1989");

  echo $dali->getLastName() . ': ';
  echo date_format($dali->getBirthDate(),'d M Y') . ' to ';
  echo date_format($dali->getDeathDate(),'d M Y'). '<hr>';

  // test the output method
  echo $picasso->outputAsTable();

  // finally test the static method: notice its syntax
  echo '<hr>';
  echo 'Number of Instantiated artists: ' . Artist::getArtistCount();

  ?>
  </body>
  </html>
```

Inheritance

Inheritance enables you to create new PHP classes that reuse, extend, and modify the behavior that is defined in another PHP class.

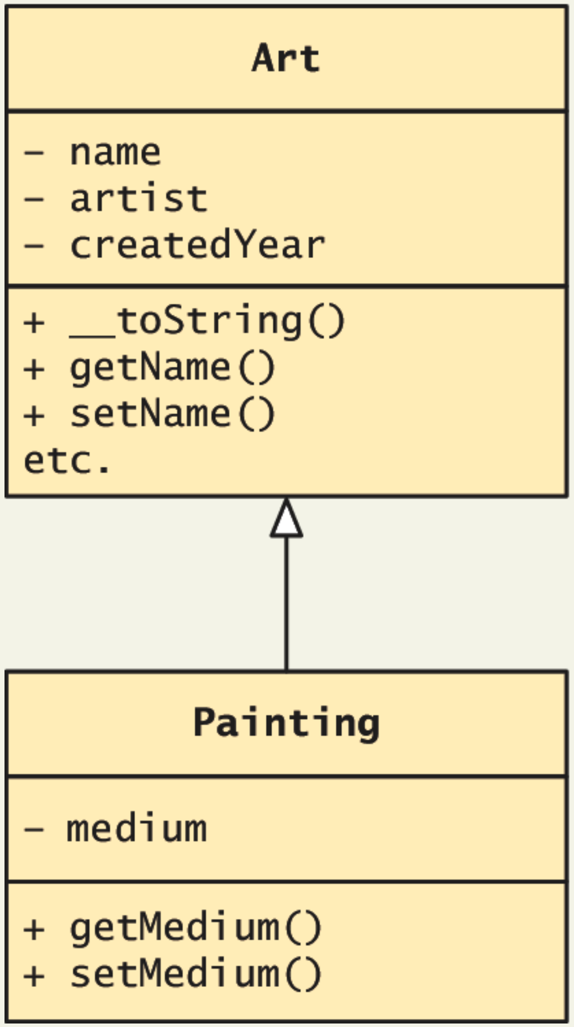
- PHP only allows you to inherit from one class at a time
- A class that is inheriting from another class is said to be a **subclass** or a **derived class**
- The class that is being inherited from is typically called a **superclass** or a **base class**

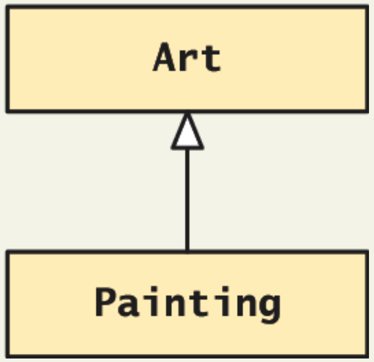
A PHP class is defined as a subclass by using the ***extends*** keyword.

class Painting **extends** Art { . . . }

Inheritance

There's UML for that too



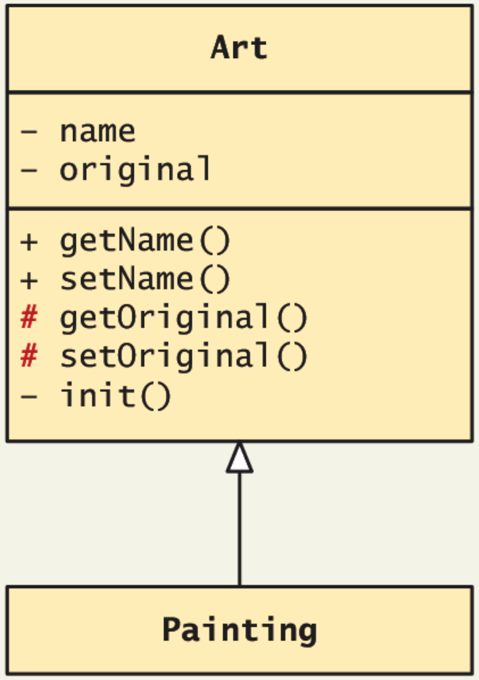


Example usage

```
$p = new Painting();

. . .

echo $p->getName(); // defined in base class

echo $p->getMedium(); // defined in subclass
```

Protected access modifier

Remember Protected?

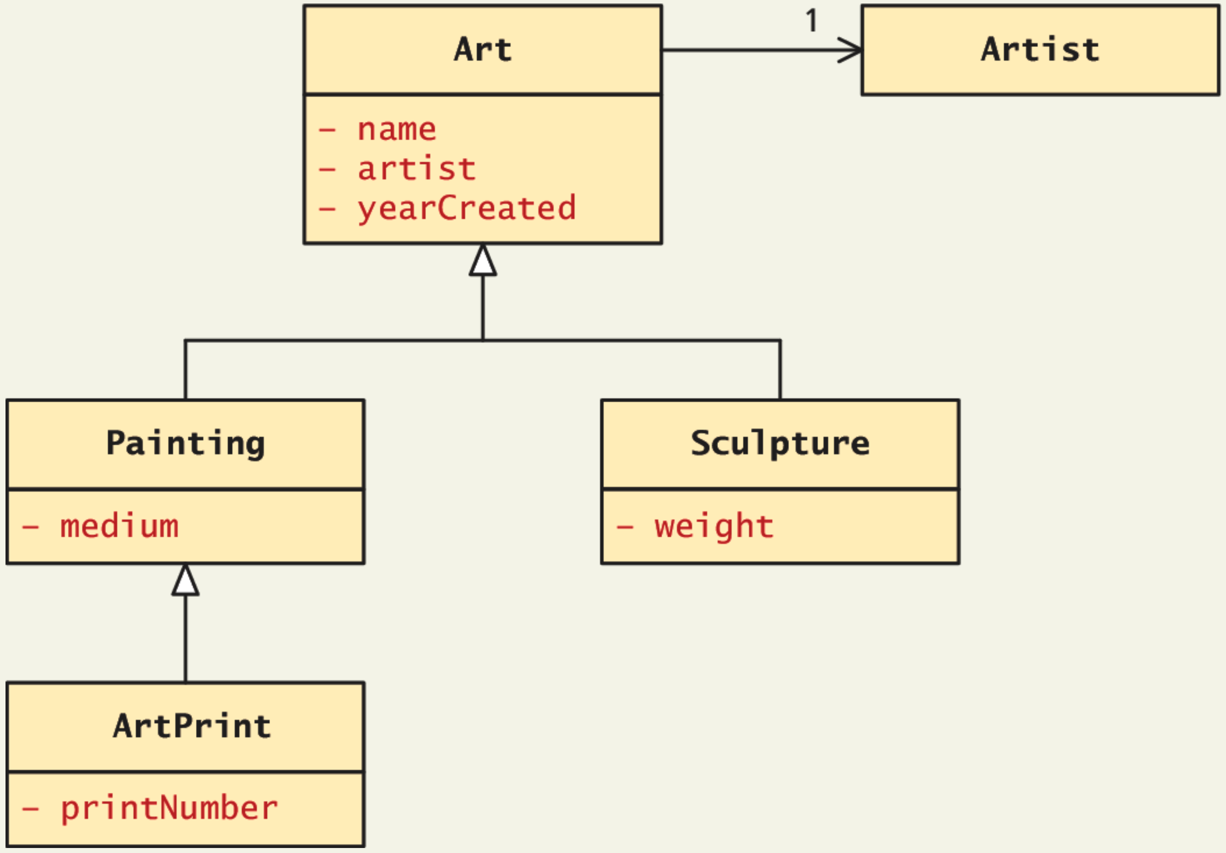


```
  class Painting extends Art {
     …
     private function foo() {
       …
       // these are allowed
✓      $w = parent::getName();
✓      $x = parent::getOriginal();

       // this is not allowed
✗      $y = parent::init();
     }
  }
```

```
  // in some page or other class
  $p = new Painting();
  $a = new Art();

  // neither of these references are allowed
✗ $w = $p->getOriginal();
✗ $y = $a->getOriginal();
```

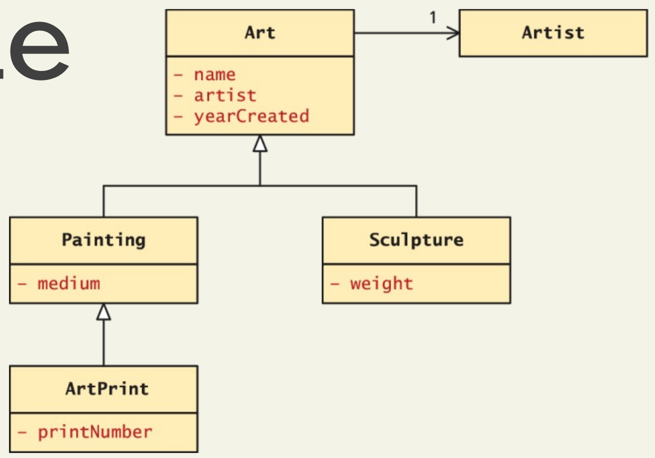
A More Complex Example

Using inheritance



Extended example

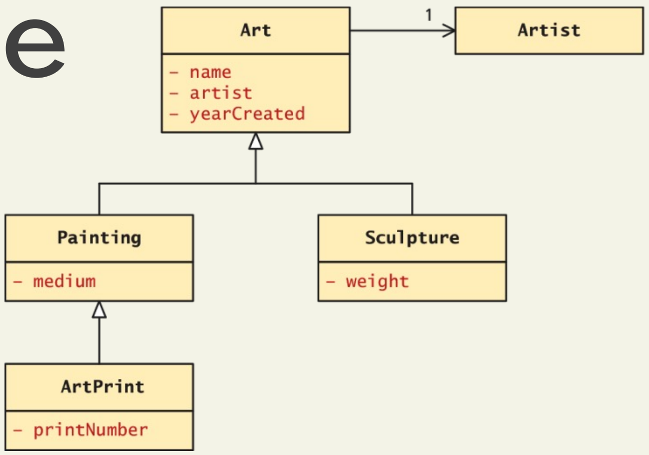
All art has certain properties



```
/* The abstract class that
 contains functionality required by
 all types of Art */

abstract class Art {

        private $name;

        private $artist;

        private $yearCreated;

        //... constructor, getters, setters
```

Extended example

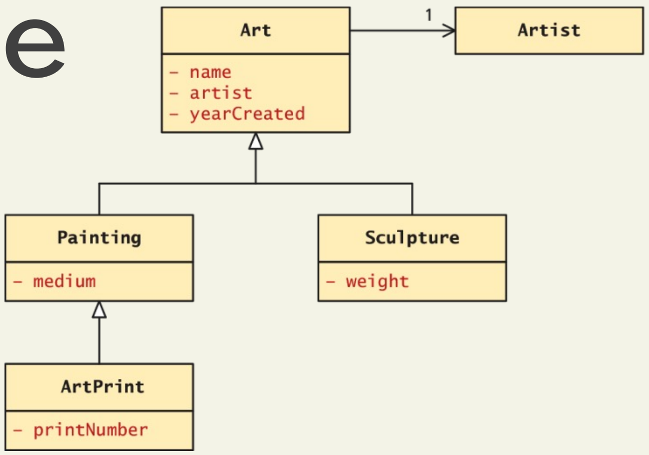
Painting require a “medium”



```
class Painting extends Art {
        private $medium;
        //...constructor, getters, setters
        public function __toString() {
            return parent::__toString() . ", Medium: " .
                                        $this->getMedium();
    }
}
```

Extended example

Sculptures have weight



```
class Sculpture extends Art {
        private $weight;
        //...constructor, getters, setters
        public function __toString() {
                return parent::__toString() . ", Weight: " .
                                $this->getWeight() ."kg";
        }
}
```

Extended example

Using the classes

```
…
$picasso = new Artist("Pablo","Picasso","Malaga","May 11,904”,"Apr 8, 1973");
$guernica = new Painting("1937",$picasso,"Guernica”, "Oil on canvas");
$woman = new Sculpture("1909",$picasso,"Head of a Woman", 30.5);
?>
<h2>Paintings</h2>
<p><em>Use the __toString() methods </em></p>
<p><?php echo $guernica; ?></p>
<h2>Sculptures</h2>
<p> <?php echo $woman; ?></p>
```

Polymorphism

No thank you, I'll have water

Polymorphism is the notion that an object can in fact be multiple things at the same time.

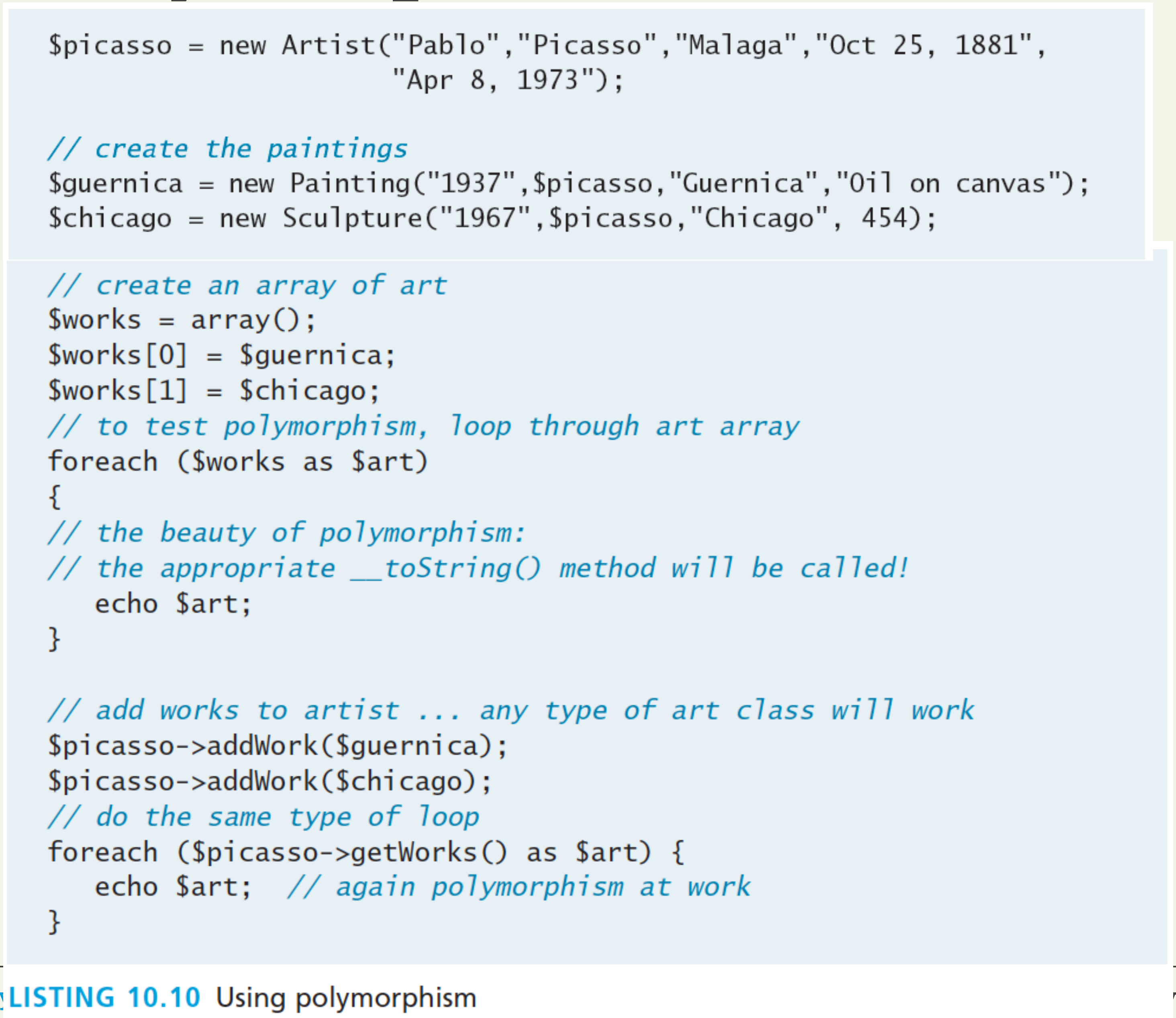
Consider an instance of a Painting object named $guernica created as follows:

$guernica = new Painting("1937",$picasso,"Guernica","Oil on canvas");

The variable $guernica is both a *Painting* object and an *Art* object due to its inheritance.

The advantage of polymorphism is that we can manage a list of Art objects, and call the same overridden method on each.

Polymorphism



```
$picasso = new Artist("Pablo","Picasso","Malaga","Oct 25, 1881",
                      "Apr 8, 1973");

// create the paintings
$guernica = new Painting("1937",$picasso,"Guernica","Oil on canvas");
$chicago = new Sculpture("1967",$picasso,"Chicago", 454);

// create an array of art
$works = array();
$works[0] = $guernica;
$works[1] = $chicago;
// to test polymorphism, loop through art array
foreach ($works as $art)
{
// the beauty of polymorphism:
// the appropriate __toString() method will be called!
   echo $art;
}

// add works to artist ... any type of art class will work
$picasso->addWork($guernica);
$picasso->addWork($chicago);
// do the same type of loop
foreach ($picasso->getWorks() as $art) {
   echo $art;  // again polymorphism at work
}
```

LISTING 10.10 Using polymorphism

Interfaces

Defining the interface

An object **interface** is a way of defining a formal list of methods that a class **must** implement without specifying their implementation.

Interfaces are defined using the **interface** keyword, and look similar to standard PHP classes, except an interface contains no properties and its methods do not have method bodies defined.

```
interface Viewable {
        public function getSize();
        public function getPNG();
}
```

Interfaces

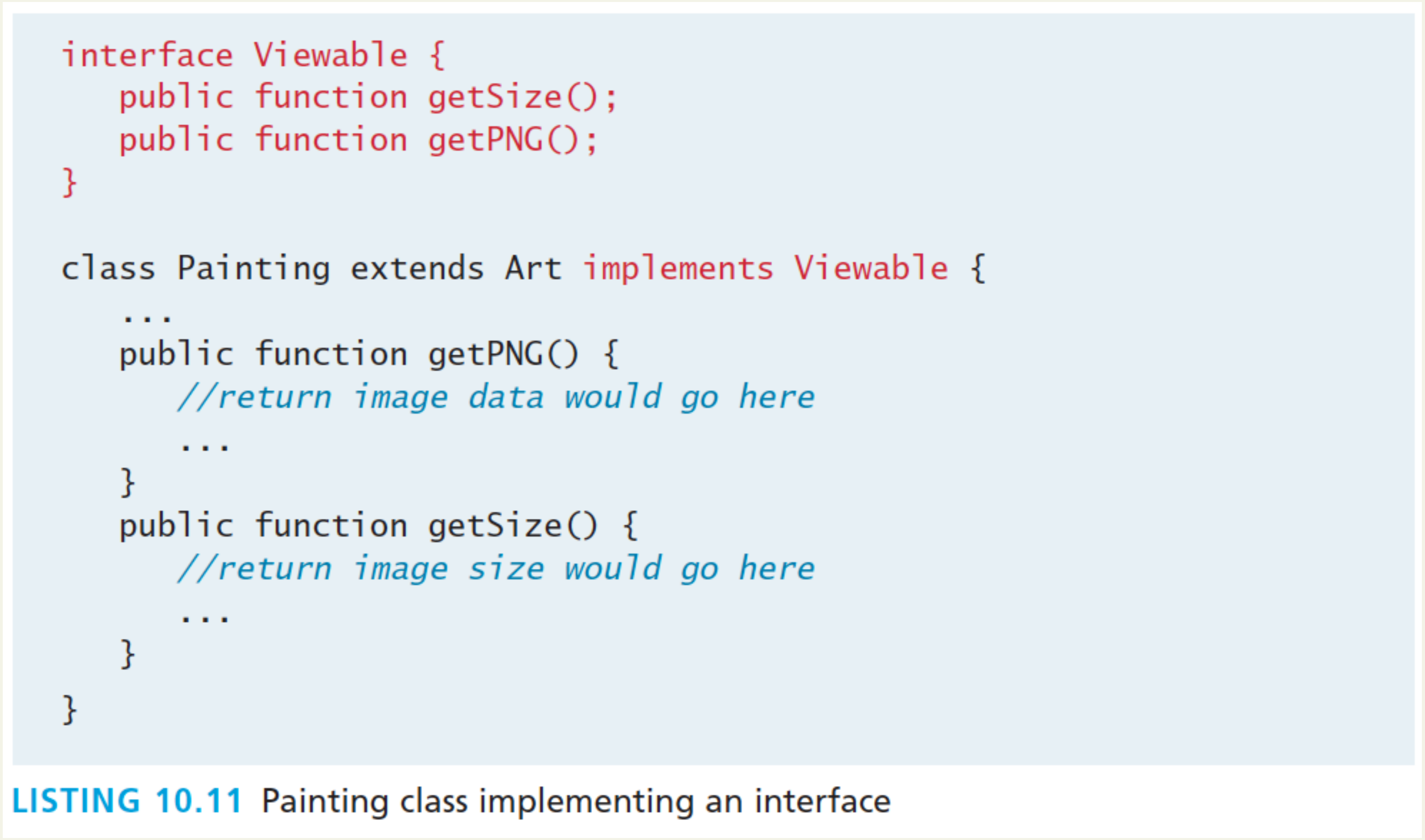
Imnplmeneting the Interface

In PHP, a class can be said to *implement* an interface, using the **implements** keyword:

class *Painting* extends Art **implements** Viewable { ... }

This means then that the class *Painting* **must** provide implementations for the *getSize()* and *getPNG()* methods.

Interface Example

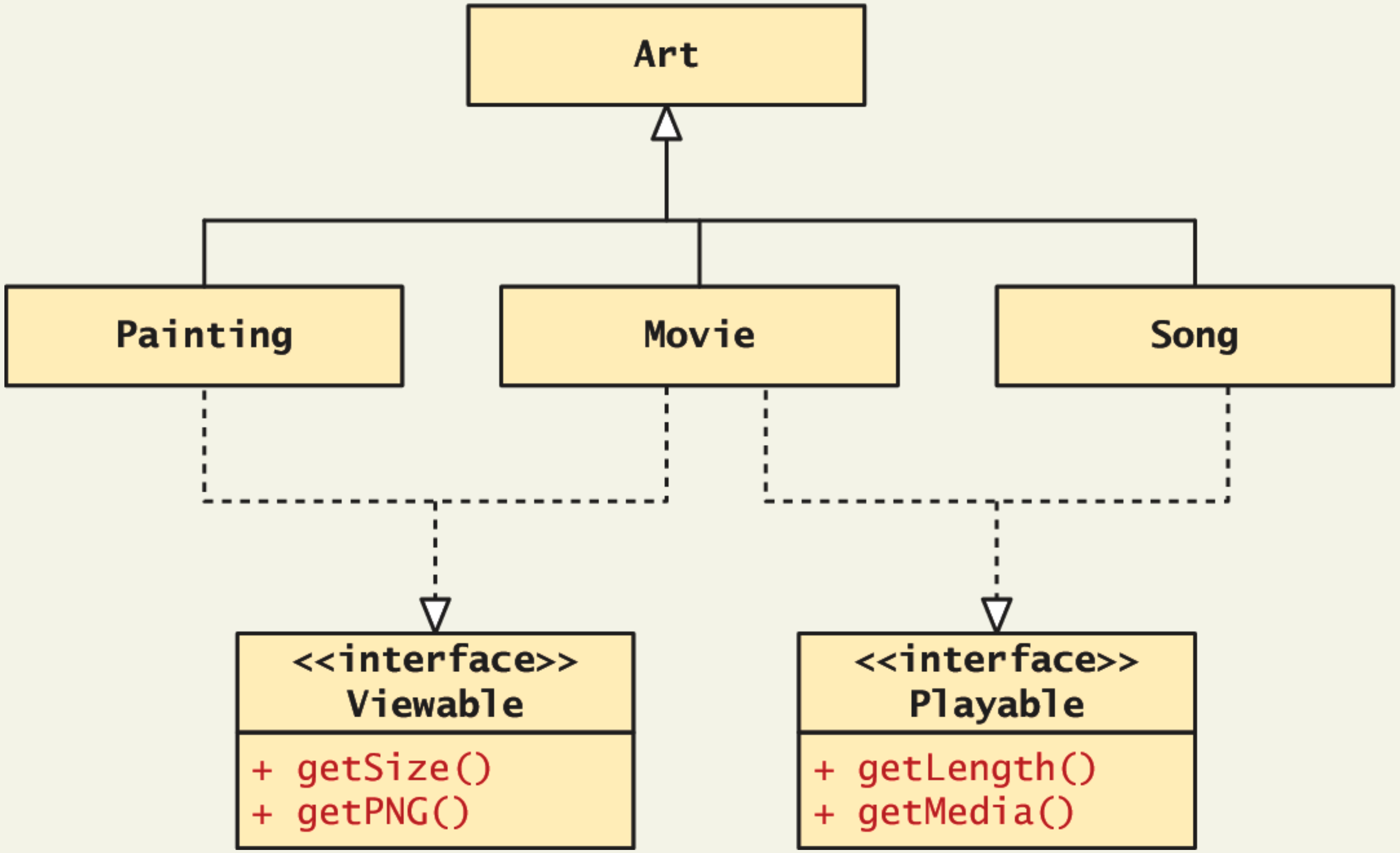


```
interface Viewable {
   public function getSize();
   public function getPNG();
}

class Painting extends Art implements Viewable {
   ...
   public function getPNG() {
      //return image data would go here
      ...
   }
   public function getSize() {
      //return image size would go here
      ...
   }
}
```

LISTING 10.11 Painting class implementing an interface

Interfaces

An Extended example



An example

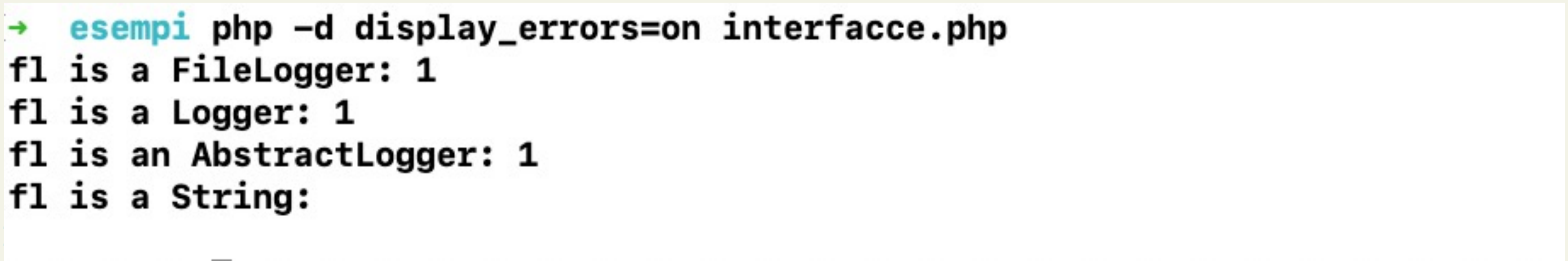
```php
<?php
interface Logger {
  public const NORMAL = 1;
  public const DEBUG = 2;
  public function log($level, $message);
}

abstract class AbstractLogger implements Logger {
  // Transfer to storage only messages
  // with a level that is greater or equal than
  private $level;

  public function __construct($level) {
    $this->level = $level;
  }
  public function log($level, $message) {
    if($this->level >= $level) {
      $this->transfer($message);
    }
  }

  protected abstract function transfer($mes);
}
```

An example

```
class FileLogger extends AbstractLogger {
  private $file;

  function __construct($filename, $level) {
    parent::__construct($level);
    $this->file = fopen($filename, "a");
  }

  protected function transfer($message) {
    fwrite($this->file, $message . "\n");
  }
}
```

```php
// Another class could extend AbractLogger and
// log the messages in a DB

// $al = new AbstractLogger();
/*
Fatal error: Uncaught Error: Cannot instantiate abstract class
AbstractLogger in
/Applications/XAMPP/xamppfiles/htdocs/esempi/interfacce.php:26
Stack trace:
#0 {main}
thrown in
/Applications/XAMPP/xamppfiles/htdocs/esempi/interfacce.php on
line 26
*/

$fl = new FileLogger("out.txt", Logger::NORMAL);
$fl->log(Logger::NORMAL, "first message"); // Logged
$fl->log(Logger::DEBUG, "second message"); // Not logged
```

```php
// Types:
// BTW: A bool true value is converted to the string "1". bool false
// is converted to "" (the empty string). This allows conversion back
// and forth between bool and string values (from the PHP manual).

echo "fl is a FileLogger: ". ($fl instanceof FileLogger);
echo "\nfl is a Logger: ". ($fl instanceof Logger);
echo "\nfl is an AbstractLogger: ". ($fl instanceof AbstractLogger);
echo "\nfl is a String: ". ($fl instanceof String);
echo "\n\n";
?>
```



```
→  esempi php -d display_errors=on interfacce.php
fl is a FileLogger: 1
fl is a Logger: 1
fl is an AbstractLogger: 1
fl is a String:
```