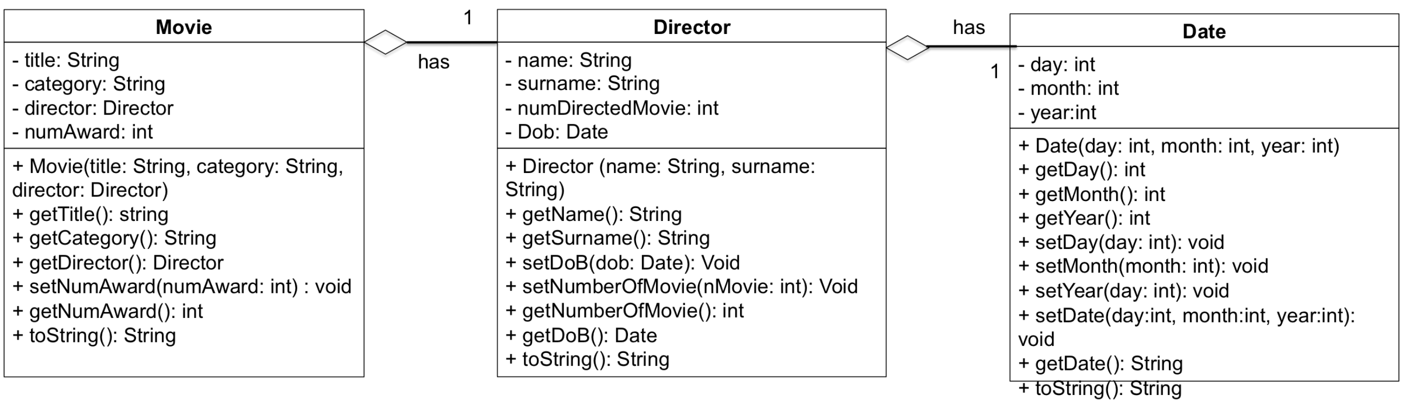
Tutorial week 2 5COSC001W – Object Oriented Programming – Java

Association, aggregation and composition

In Object-oriented programming, one object can be related to other objects to use functionalities and services provided by those objects.
Association: relationship between two objects and is depicted by an arrow in Unified Modelling language or UML.
Aggregation: special form of association. It is a directional association, which means it is strictly a *one-way* association. It represents a *Has-A* relationship.
Composition: stronger form of aggregation. One class owns other class and other class cannot meaningfully exist. It represents an *Owns-A* relationship.

1) Analyse the following UML diagram and explain the relationship between the classes. Which association there is between the classes and why?



Date Class

A class Date has been designed to model a date as shown in the class diagram.

This class contains:

- Three *private instance variables*. They represent day (int), month (int), and year (int).

- One *constructor* to inizialize the date with values:
  `public Date (int day, int month, int year) { //write code here }`

- Public *getters* and *setters*:

```
public void setDay(int day){ // write code here}

public void setMonth(int month){ // write code here}

public void setYear(int year){ // write code here}

public int getDay(){ //write code here}

public int getMonth(){ //write code here}

public int getYear(){ //write code here}
```

- A *toString()* method that returns the string "Date[day = ?, month = ?, year =?]"
  Example : `"Date [ day = 23, month = 11, year = 2020]`

  If you don't remember the functionality of the "toString()" method go to revise it in the file "Week 01 – Indipendednt Study"

Director Class

A class Director has been designed to model a movie's director as shown in the class diagram.

This class contains:

- Four *private instance variables*. They represent name (string), surname (string), the number of movies directed (int) and the date of birth (Date) of the director.

- One *constructor* to inizialize the name and the surname of the Director with values:
  `public Director (String name, String Surname) { … }`

- Public *getters* and *setters*:

  ```
  public  string getName(){ … }

  public  string getSurname(){ … }

  public  Date getDoB(){ … }

  public int getNumberOfMovie(){ … }

  public void setDoB(Date date) { … }

  public void setNumberOfMovie (int num) { … }
  ```

  There are no setter methods for name and surname because we don't want to change these attributes.

- A *toString()* method that returns the string "Director[name = ?, surname = ?, dob = ?, movies directed = ?]"
  Example : `"Director [ name = James, surname = Cameron, dob = 16/8/1954, movies directed = 23]`

2) Write the class Director base on the UML diagram. Note that the class Director uses a Date object to represent the date of birth of the director. You can use the implementation of the class Date that you wrote in the previus tutorial.

3) Write a test class to test the public methods you implemented. Note that you should create an instance of *Date* before you can construct an instance of *Director*:

```
/*
 * A test class for the Director class.
 */
public class Test {
   public static void main(String[] args) {

      // Test constructor
      Director director = new Director("James", "Cameron");

      // Test Setters and Getters

      // Crete an object Date to represent the dob
      Date dob = new Date(16, 8, 1954);
      director.setDoB(dob);

      director.setNumberOfMovie(23);

      System.out.println(director);  // toString()
      System.out.println("name is: " + director.getName());
      System.out.println("surname is: " + director.getSurname());
      System.out.println("dob is: " + director.getDoB().getDate());
      System.out.println("number of directed movies is: " +
                          director.getNumberOfMovie());
```

```
        }
    }
```

Movie Class

4) As you can see from the class diagram, a class called *Movie* is designed to model a movie directed by a *director.* This class contains:

- Four *private instance variables*. They represent the title of the movie (string), the category (string), the number of awards (int) and the director (Director).

- One *constructor* to inizialize the title and the category, the name of the Director, with values:

```
public Movie (String title, String category, Director director) { … }
```

- Public *getters* and *setters*:

```
public  string getTitle(){ … }

public  string getCategory() { … }

public Director getDirector() { … }

public void setNumAwards(int numAwards) { … }

public int getNumAwards() { … }
```

- A *toString()* method that returns the string “Movie[title = ?, category = ?, director name = ?, director surname = ?, number of awards = ?]”

  Example : “`Movie [ title = Avatar, category = Fantasy, director name = James, director surname = Cameron, number of awards = 3]`

5) Write the class *Movie* base on the UML diagram. This class uses the *Director* class written earlier.

6) Write a test class to test all the public method in the class *Movie*. Note that you have to create an instance of *Director* before you can construct an instance of *Movie*.

```
/*
 * A test program for the Movie class.
 */
public class Test {
   public static void main(String[] args) {

      // We need a Director instance to create a Movie instance
      Director director = new Director("James", "Cameron");
      Date dob = new Date(16, 8, 1954);
      director.setDoB(dob);
      director.setNumberOfMovie(23);

      System.out.println(director);  // Director's toString()

      // Test Movie's constructor and toString()
      Movie movie = new Movie("Avatar", "Fantasy",director);
      System.out.println(movie);  // Movie's toString()

      // Test Setters and Getters
      movie.setNumAwards(23);

      System.out.println(movie);  // Book's toString()
```

```
        System.out.println("title is: " + movie.getTitle());
        System.out.println("category is: " + movie.getCategory ());
        System.out.println("name of director is: " + movie.getDirector().getName());
        System.out.println("surname of director is: " + movie.getDirector().getSurname());
        System.out.println("number of awards is " + movie.getNumAwards());
    }
}
```

9) Improve the class Date:

- Add the input validation when the user inserts the date according to the values in the orange box shown in the figure above.
- Modify the method `getDate()` in order to return the date in the form gg/mm/yyyy. Add a leading zero when is needed.

Static variables and static methods

Static Methods can access class variables without using object of the class. A method may be declared with the *static* keyword. Static methods live at *class level*, not at *object level*. Static methods *may access* static variables and methods, but not dynamic ones.

Static variables are also known as *Class Variables*. The main caratheristics of this variables are:

- Data stored in static variables is common for all the objects(or instances) of that Class.
- Memory allocation for such variables only happens once when the class is loaded in the memory.
- These variables can be accessed in any other class using class name.

10) Consider the following class:

```
public class IdentifyVariables {
    public static int x = 7;
    public int y = 3;
}
```

Which are the class variables?

Which are the instance variables?

Based on the class in 7), which is the output of the following code?

```
IdentifyVariables a = new IdentifyVariables ();
IdentifyVariables b = new IdentifyVariables ();
a.y = 5;
b.y = 6;
a.x = 1;
b.x = 2;
System.out.println("a.y = " + a.y);
System.out.println("b.y = " + b.y);
System.out.println("a.x = " + a.x);
System.out.println("b.x = " + b.x);
System.out.println("IdentifyVariables.x = " + IdentifyVariables.x);
```

Some extra exercises

Extend the UML digram in section 1), adding a class *Actor*. This class should provide instance variables, constructors and setter and getter methods. In the class Movie, add an instance variable that represents a list of actors playing in that movie. Since more than one actor plays a movie you should create a variable `actor:Actor[].` This is an array of Actor objects.

You can declare and use an array of object in the following way:

```
Actor listActor[] = new Actor[10]; // it will create an array of 10 actors

listActor[0] = new Actor(); // it will create an object Actor and save in position 0

listActor[0].setName();
```

…

Write a Test class to test the new *Actor* class and the usage of the class within the *Movie* class.