SCIT

School of Computing and Information Technology
Faculty of Engineering & Information Sciences

CSIT121
Object Oriented Design and Programming
Assignment 2
File name: YourName_XXX_A2.java
(XXX your class list no)

Objectives:

Practice java programming with inheritance and polymorphism.

Task (6 marks)

Implement the Shape hierarchy shown in Fig. 1 (Class name in *italic* indicates an abstract class).

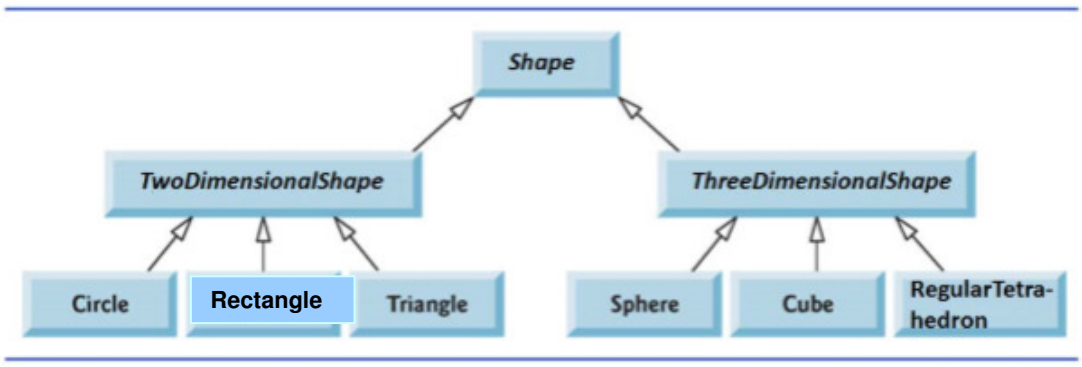


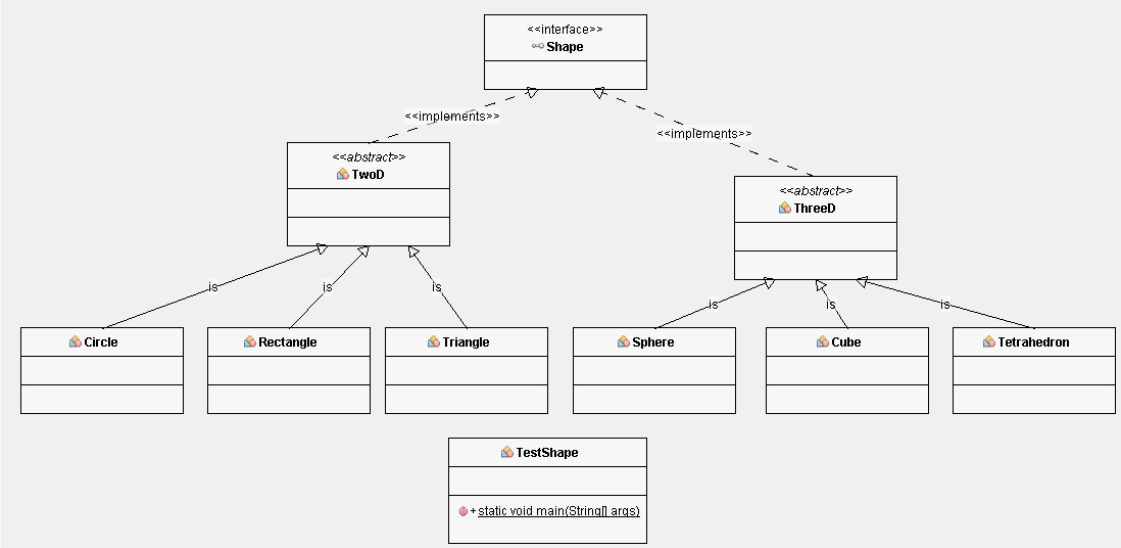
Fig 1: Inheritance hierarchy of Shapes

- Each `TwoDimensionalShape` should contain methods `area` and `getArea` to calculate and to return the area of the two-dimensional shape.

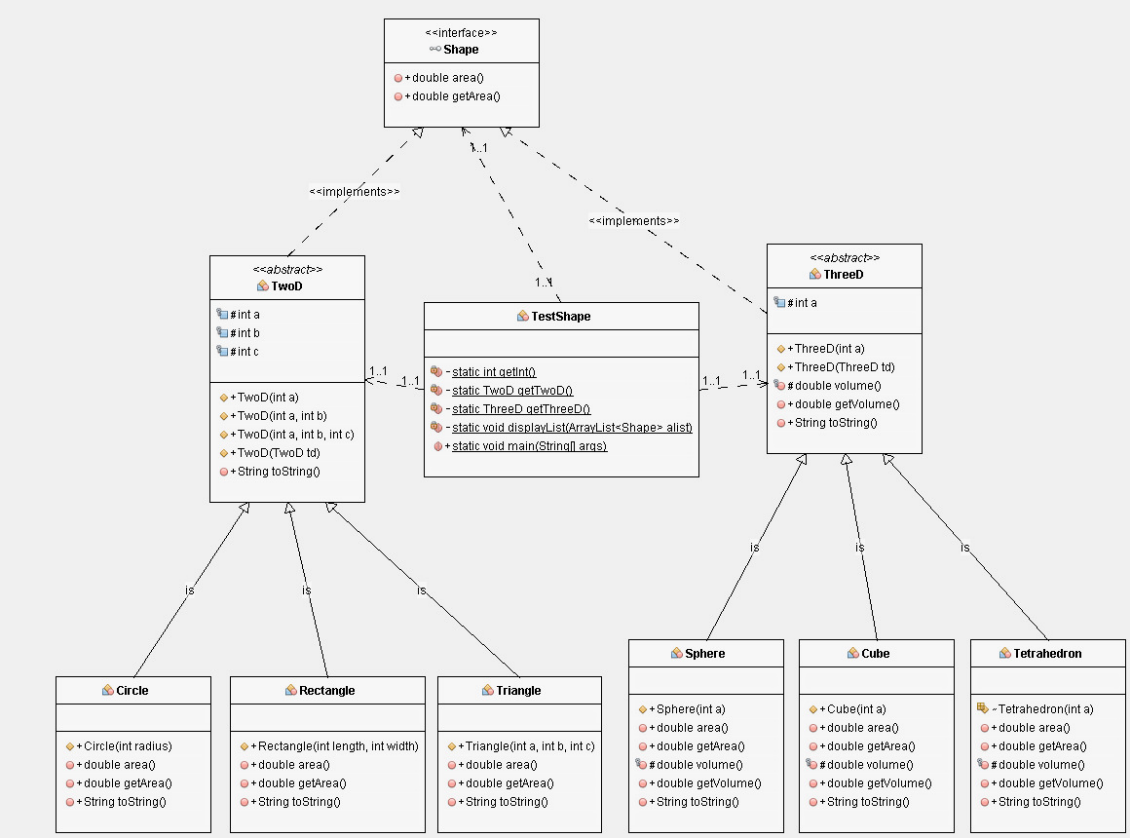
- Each `ThreeDimensionalShape` should have methods `area`, `getArea`, `volume` and `getVolume` to calculate and to return the surface area and the volume, respectively, of the three-dimensional shape.

- Try to surf the internet to look for some formulas, for example, to compute the areas, the surface areas and the volumes … I did that too ☺

- The following UML diagram show briefly their relationship:

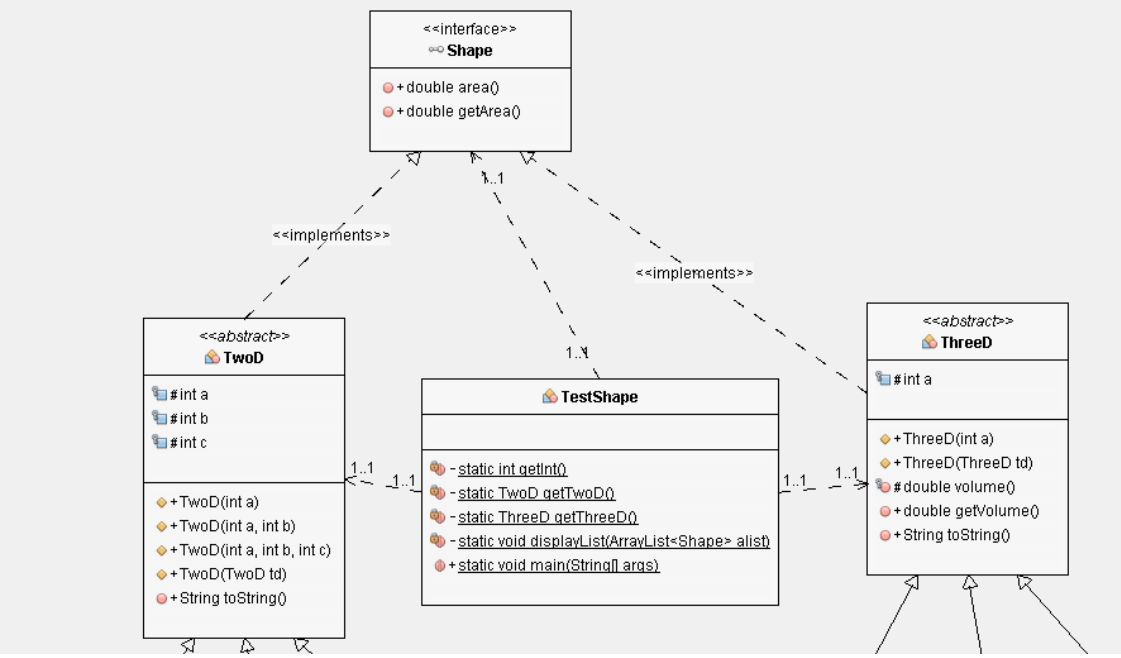


A more detailed UML diagram: (Note that the #'s before the instance variables and the methods' names mean "protected")



Wow … so difficult to see ☺

Let us explore the above UML diagram. At the highest hierarchy, you can see that `Shape` is an interface class. Two abstract classes `TwoD` and `ThreeD` will need to implement the `Shape` interface

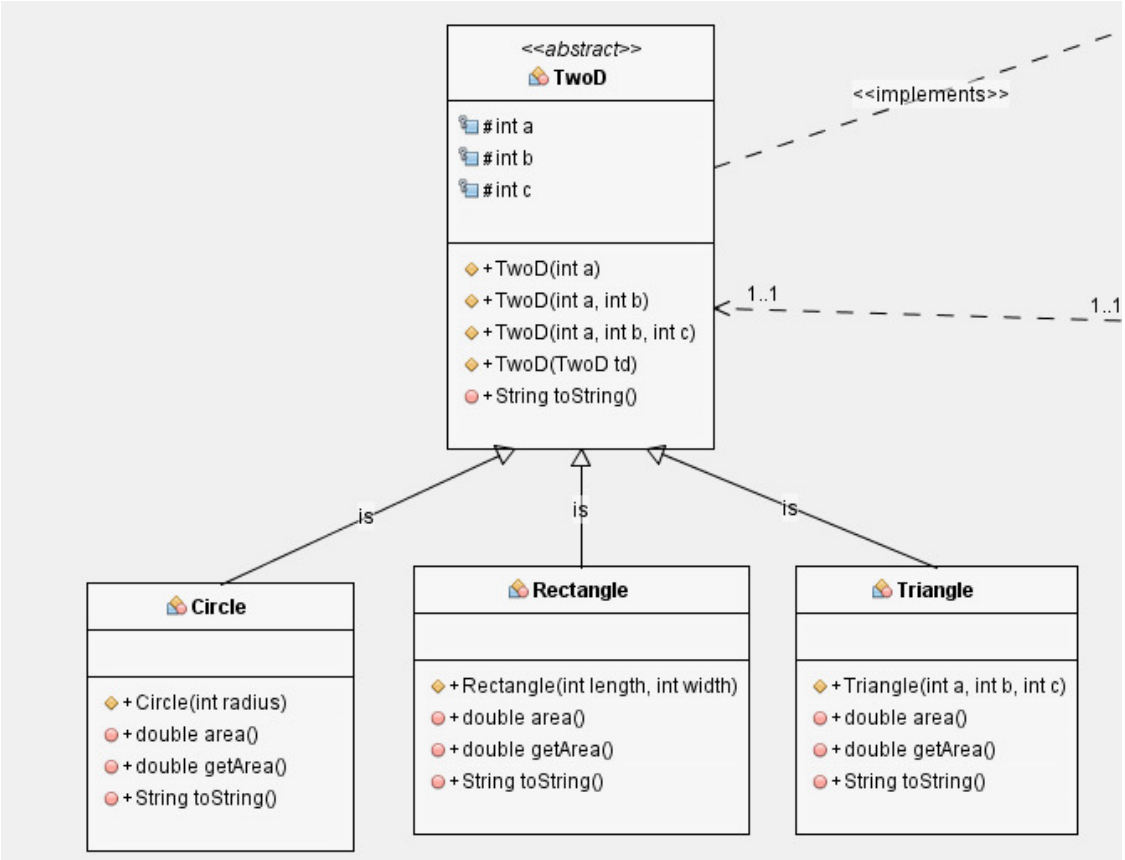


The UML diagram `TestShape` between the `TwoD` and the `ThreeD` will be the main class that has a main method. We will discuss it later.

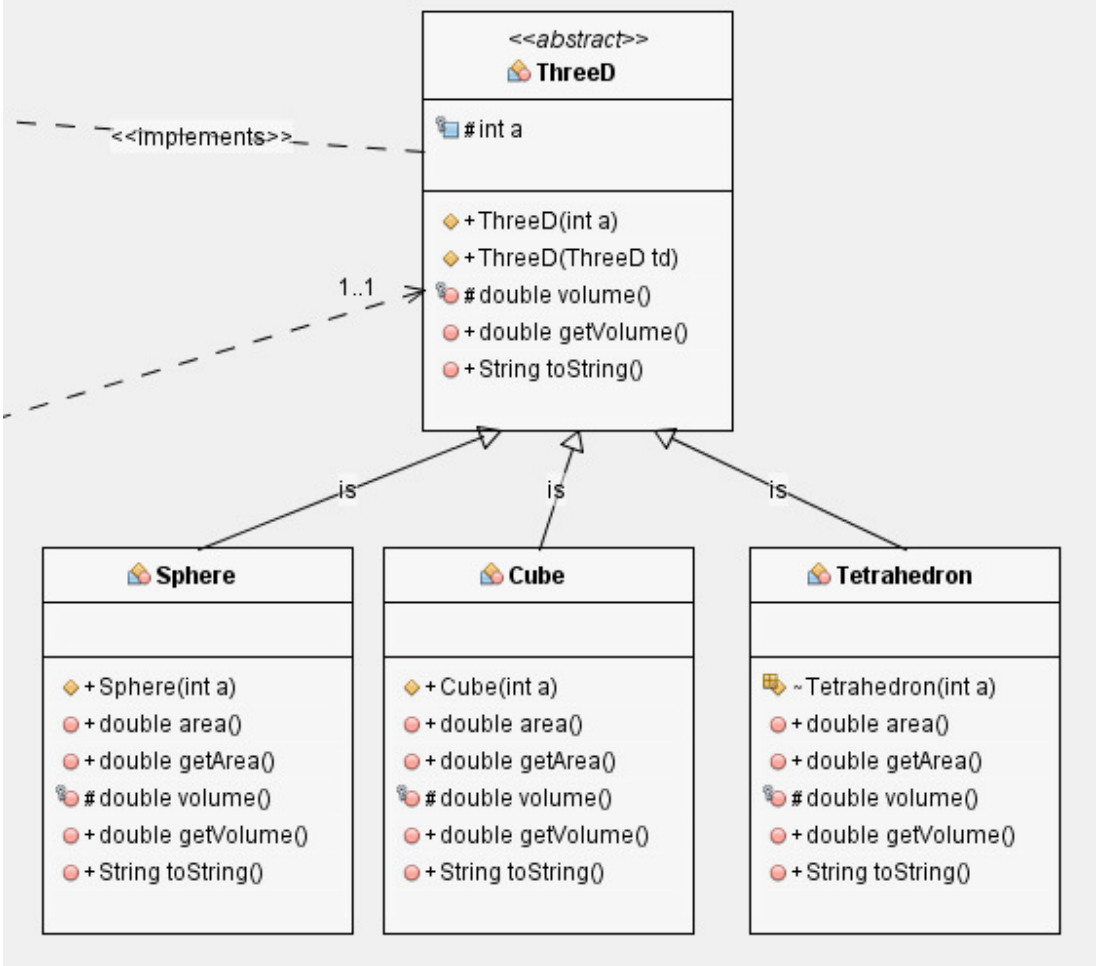
Three possible shapes for `TwoD`: one value, for example the radius, is a circle shape; two values, for example the length and the width, is a rectangle; and three values for example the three sides of a triangle (provided it can be formed). In this class, you can see that we have three constructors to describe the three shapes, a copy constructor and a `toString` method.

Note that accessor and the mutator methods did not show in the diagram, you should add them in.

The following UML diagram shows the three subclasses of `TwoD`:

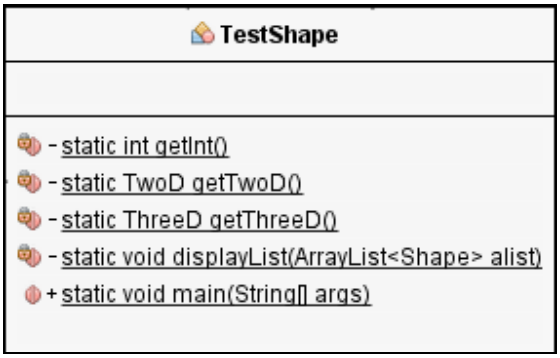


Three possible shapes for `ThreeD`: Just one value can determine the shapes of a sphere, a cube and or a tetrahedron. In this class, we only have one constructor, a copy constructor, and a `toString` method. *Again the accessor and mutator methods are missing the diagrams; you should add them in too*. For a 3D object, we can compute and return the volume too. Therefore we have *two additional abstract methods* in this abstract class `ThreeD`. Let us now look at the UML diagram for the three subclasses of `ThreeD` class:



Look for the surface area and volume formulas somewhere in internet to compute and to return their values ☺

Let us now explore the main class, i.e. main method is defined in this class



All shapes (2D or 3D) should be *randomly generated* and store them in an ArrayList of `Shape`.

You can see a few private class methods defined in this class (`TestShape`):

- a method generates and returns a single positive integer
- a method generates and returns a TwoD shape
- a method generates and returns a ThreeD shape
- a method to display the objects stored in the ArrayList:

```
Shape [1] = Triangle (2D (5, 5, 2))==> Area = 4.899
I am a triangle shape
------------------------------
Shape [2] = Sphere (3D (1))==> Surface area = 12.566, Volume = 4.189
I am a sphere shape
------------------------------
Shape [3] = Circle (2D (3))==> Area = 28.274
I am a Circle shape
------------------------------
Shape [4] = Tetrahedron (3D (9))==> Surface area = 140.296, Volume = 85.913
I am a tetraheron shape
------------------------------
Shape [5] = Rectangle (2D (3, 3))==> Area = 9.000
I am a rectangle shape
------------------------------
Shape [6] = Cube (3D (6))==> Surface area = 216.000, Volume = 216.000
I am a cube shape
------------------------------
Shape [7] = Triangle (2D (8, 6, 4))==> Area = 11.619
I am a triangle shape
------------------------------
Shape [8] = Tetrahedron (3D (10))==> Surface area = 173.205, Volume = 117.851
I am a tetraheron shape
------------------------------
Shape [9] = Rectangle (2D (10, 9))==> Area = 90.000
I am a rectangle shape
```

IMPORTANT

Put all your classes in a file called **`YourName_XXX_A2.java`** and make sure that this file can be compiled and can be executed. Upload **ONLY** this file to Moodle**. ALL ZIP FILE SUBMITTED WILL BE REJECTED. XXX is your class list no. Check this number from Moodle system**

No re-submission will be allowed after grading.

In the above file, remember to put down your name and also the following declaration (some similar contents):

```
// Tell me if it is your own work, and whether you have passed your
// program to your friends etc etc etc
// and willing to accept whatever penalty given to you.
```

- **Wrong file name -0.5 mark**
- **No declaration, no name etc -1 mark**
- **Failing to demo -1.5 marks**