- Experiment 5 -

Create a Java project named Experiment5 and create the following classes in the project.

1. Define a public class named Rectangle as follows:

```java
public class Rectangle {
    private double length, width;
    Rectangle() { }
    Rectangle(double l, double w) { length=l; width=w; }
    public void setLength(double l) { length=l; }
    public void setWidth(double w) { width=w; }
    public double getLength() { return length; }
    public double getWidth() { return width; }
    public double area() { return length*width; }
    public double perimeter() { return (length+width)*2; }
    public void showMe() {
        System.out.print("矩形:长"+length+",宽"+width);
        System.out.println(",周长"+perimeter()+",面积"+area());
    }
}
```

Define another public class named Cuboid, which inherits the Rectangle class above, and it has:

   A private instance field -- height; //The height of a cuboid;

   Constructors // no-argument and with parameters

   Five methods

     setHeight() //Set the height of a cuboid

     getHeight() //Get the height of a cuboid
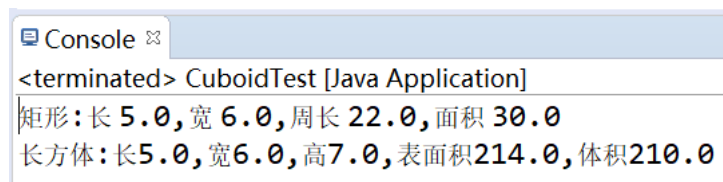
     area()   // the surface area of a cuboid

     volume() // the volume of a cuboid

     showMe() //Display the length, width, height, surface area and volume of a cuboid, respectively

Next, define a public class CuboidTest, which has a main method, in the main method, you need to create two objects, one for Rectangle, the other for Cuboid, and display the information by calling showMe method.

[Sample]

```
Console ⊠
<terminated> CuboidTest [Java Application]
矩形:长 5.0,宽 6.0,周长 22.0,面积 30.0
长方体:长5.0,宽6.0,高7.0,表面积214.0,体积210.0
```

2. Define a public class named TestGeometry as follows:

```java
public class TestGeometry {
    public static void main(String[] args) {
        Circle c=new Circle(10);
        System.out.println(c); //c.toString()
        Cylinder cy=new Cylinder(10, 5);
```

```
            System.out.println(cy);
        }
    }
```
Complete the definition of class Circle and class Cylinder, where Cylinder is a subclass of Circle.

[Sample]

3. Write a program which can make musicians play musical instruments. The musical instruments include erhu(二胡), piano and violin. One musician can play different musical instruments to produce different sounds, and many musicians can play the same type of instruments to produce wonderful sounds.

Realization ideas:

Given an abstract class as follows:

```java
public abstract class Instrument {
    public abstract String makeSound();
}
```

Define three subclasses of class Instrument: Erhu, Piano and Violin, and define a public class named Musician for musicians, including the method *play (Instrument i)* to play various instruments.

Define a public class named TestInstrument as follows:

```java
public class TestInstrument {
    public static void main(String[] args) {
        Musician bob=new Musician("bob");
        Erhu erhu=new Erhu();
        Piano piano=new Piano();
        Violin violin=new Violin();
        System.out.println("Player: "+bob.getName());
        bob.play(erhu);
        bob.play(violin);
        bob.play(piano);
        System.out.println("Instrument: "+piano.getName());
        Musician[] players= { new Musician("tom"),
                new Musician("jerry"), new Musician("mickey"),
                new Musician("pluto") };
        for (Musician player : players)
            player.play(piano);
    }
}
```

[Sample]

4. Define an abstract class Shape, which contains two public abstract methods: area() and perimeter().

Next, define class Oval which inherits class Shape, and implements the abstract methods of class Shape; and define class Ellipsoid which inherits class Oval, class Ellipsoid has a method area() for finding the surface area.

Finally, define a main class GeometryTest to complete the following tasks:

First declare an object variable of class Shape named **shape**, and use a while loop to repeatedly receive keyboard input.

When you enter 1, you are prompted to enter two semi-axes a and b of an ellipse, use **shape** to refer to an Ellipse object, and output the perimeter and area of the object;

When inputting 2, you are prompted to enter the lengths a, b and c of the three semi-axes of an Ellipsoid object, use **shape** to refer to an Ellipsoid object, and then output the surface area of the object;

When the input is not 1 or 2, exit the program.

[Sample]