Basis of Computer Programming (java A)
Tutorial 8

(The source code and document description are designed by ZHU Yueming)

[Experimental Objective]

- Learn how to define a Java class
- Learn how to use instance variables
- Learn how to define and use instance methods
- Learn how to use get and set methods
- Learn how to use ArrayList.

[Before Exercises]

Step1: Thinking about how can we describe a circle?

A circle may have three attributes including the radius, the x position and the y position.

Then we build a class named circle, in which there are three attributes

```
public class Circle {
        private double radius;
        private double x;
        private double y;
}
```

Step2: Thinking about how can we understand the area, the position and the perimeter of the circle?

Then we need to build three methods to describe the area, position and perimeter of current circle.

```
public class Circle {
        private double radius;
        private double x;
        private double y;

        public double area() {
                return radius*radius*Math.PI;
        }

        public double perimeter () {
                return 2*Math.PI*radius;
        }


        public void position() {
                System.out.printf("Position of the cricle is (%.1f,%.1f)\n",x,y);
        }
}
```

Step3: Thinking about how can we use the circle?

Create another class named CircleTest in the same package, in which there is a main method to be used for testing.

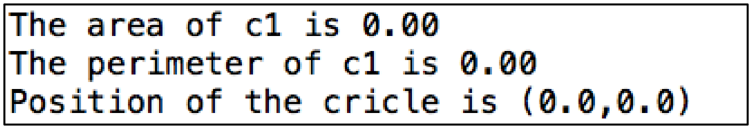
In the main method, we can create an object of Circle by using the statement as follows:

```
Circle c1=new Circle();
```

After that, we want to know the perimeter, area and position about the c1, so we need to invoke the method of c1.

```
public class CircleTest {

	public static void main(String[] args) {
		Circle c1=new Circle();
		System.out.printf("The area of c1 is %.2f\n", c1.area());
		System.out.printf("The perimeter of c1 is %.2f\n", c1.perimeter());
		c1.position();
	}
}
```

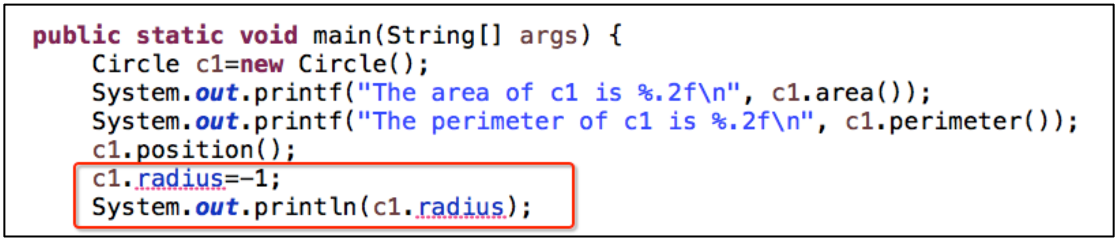
When we run the program, the result would as follows:



```
The area of c1 is 0.00
The perimeter of c1 is 0.00
Position of the cricle is (0.0,0.0)
```

Step4: Thinking about how can we set or get the value of the attributes?

If we set or get the value of radius in main method directly, it would meet an error because of its private privilege. In addition, a negative number couldn't describe the radius of a circle, how can we solve this problem?



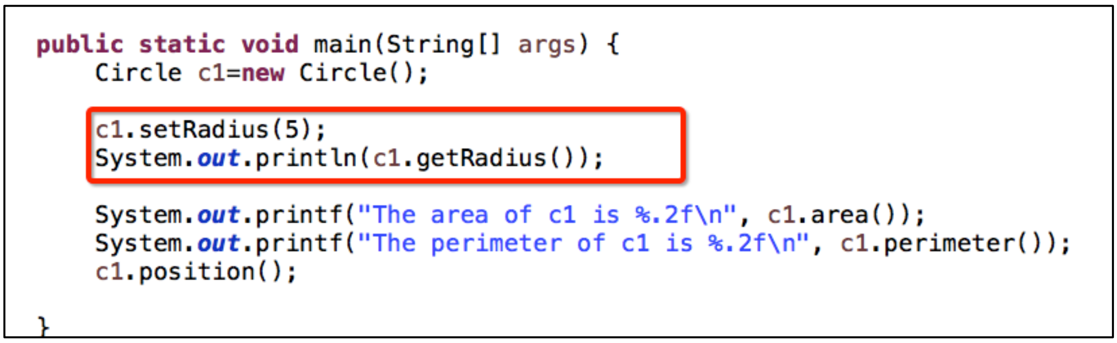
```
public static void main(String[] args) {
    Circle c1=new Circle();
    System.out.printf("The area of c1 is %.2f\n", c1.area());
    System.out.printf("The perimeter of c1 is %.2f\n", c1.perimeter());
    c1.position();
    c1.radius=-1;
    System.out.println(c1.radius);
```

Then we can define several public methods in Circle for getting or setting the attributes, and we can check the validity of input value in setting method.

```
public class Circle {
	private double radius;
	private double x;
	private double y;

	public double area() {
		return radius*radius*Math.PI;
	}
```

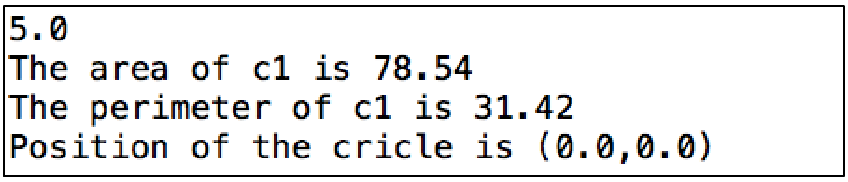
```
        public double perimeter () {
                return 2*Math.PI*radius;
        }

        public void position() {
                System.out.printf("Position of the cricle is (%.1f,%.1f)\n",x,y);
        }

        public double getRadius() {
                return radius;
        }

        public void setRadius(double radius) {
                if (radius > 0) {
                        this.radius = radius;
                }
        }

        public double getX() {
                return x;
        }

        public void setX(double x) {
                this.x = x;
        }

        public double getY() {
                return y;
        }

        public void setY(double y) {
                this.y = y;
        }
}
```

After that, we can visit the attribute by get or set method.



```
public static void main(String[] args) {
    Circle c1=new Circle();

    c1.setRadius(5);
    System.out.println(c1.getRadius());

    System.out.printf("The area of c1 is %.2f\n", c1.area());
    System.out.printf("The perimeter of c1 is %.2f\n", c1.perimeter());
    c1.position();

}
```

The result would as follows:

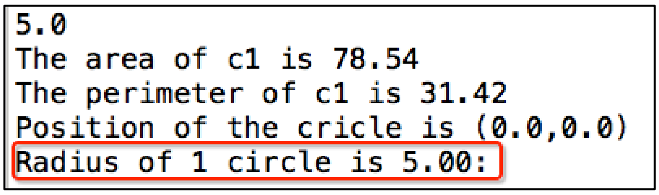


```
5.0
The area of c1 is 78.54
The perimeter of c1 is 31.42
Position of the cricle is (0.0,0.0)
```

Step5: If there are several circles, how can we manage them together?
We can use an array or ArrayList to manage them.
In main method, create an arrayList with a Circle type, in which we can store many objects of Circle.
Adding following code at the end of main method.

```
ArrayList<Circle> circleList=new ArrayList<Circle>();
circleList.add(c1);
System.out.printf("Radius of %d circle is %.2f:
\n",1,circleList.get(0).getRadius());
```

The result would as follows:

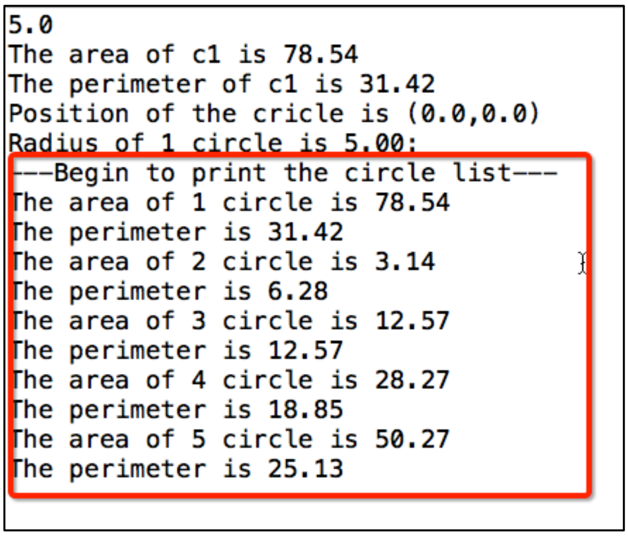


```
5.0
The area of c1 is 78.54
The perimeter of c1 is 31.42
Position of the cricle is (0.0,0.0)
Radius of 1 circle is 5.00:
```

Step5: Adding more circles in circleList.
Adding following code at the end of main method.

```
for(int i=1;i<5;i++) {
        circleList.add(new Circle());
        circleList.get(i).setRadius(i);
        circleList.get(i).setX(Math.random()*5);
        circleList.get(i).setY(Math.random()*5);
 }

 System.out.println("---Begin to print the circle list---");
 for(int i=0;i<5;i++) {
        System.out.printf("The area of %d circle is %.2f\n",
                        i+1, circleList.get(i).area());
        System.out.printf("The perimeter is %.2f\n",
                        circleList.get(i).perimeter());
 }
```

The result would as follows:



```
5.0
The area of c1 is 78.54
The perimeter of c1 is 31.42
Position of the cricle is (0.0,0.0)
Radius of 1 circle is 5.00:
---Begin to print the circle list---
The area of 1 circle is 78.54
The perimeter is 31.42
The area of 2 circle is 3.14
The perimeter is 6.28
The area of 3 circle is 12.57
The perimeter is 12.57
The area of 4 circle is 28.27
The perimeter is 18.85
The area of 5 circle is 50.27
The perimeter is 25.13
```

[Exercises]

1. Design a class named **User**. The class contains:

a. Private data fields **name** (String), **password** (String), **money** (double).

b. Design a public method named **introduce()** to print the user name and his money.

c. Design a public method named **expense()** with a double parameter, which means the money of current user should be subtracted by this parameter.

d. Design a public method named **income()** with a double parameter, which means the money of current user should be added by this parameter.

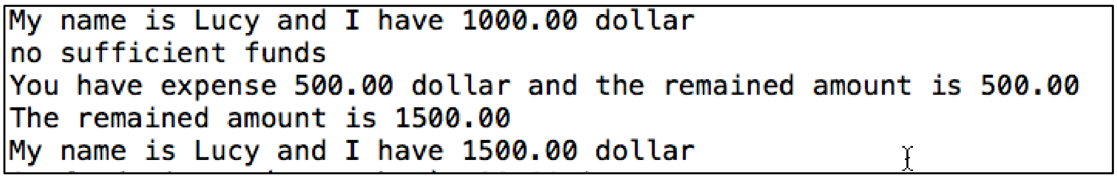
e. Design the **getter** and **setter** method for each private field of User.

In same package, we create a class named **ClientTest**, in which there is a main method. In main method, if we write down following statement, the result would as follows:

Statements in main method:

```
public static void main(String[] args) {
        User user =new User();
        user.setName("Lucy");
        user.setPassword("123456");
        user.setMoney(1000);
        user.introduce();
        user.expense(2000);
        user.expense(500);
        user.income(1000);
        user.introduce();
}
```

Result:



```
My name is Lucy and I have 1000.00 dollar
no sufficient funds
You have expense 500.00 dollar and the remained amount is 500.00
The remained amount is 1500.00
My name is Lucy and I have 1500.00 dollar
```

2. Design a class named **Food**. The class contains:

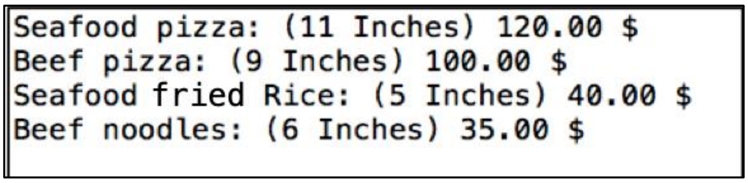
a. Private data fields **name** (String), **type** (String), **size** (int), **price** (double).
b. Design a public method named **showInformation()** to print the all information of this food as a format *(in output graph).*
c. Design the **getter** and **setter** method for each private field of Food.

In ClientTest class, please create four objects of Food as follows:

Object Name	name	type	size	price
pizza1	pizza	Seafood	11	120
pizza2	pizza	Beef	9	100
fried Rice	fried Rice	Seafood	5	40
noodles	noodles	Beef	6	35

Please create an ArrayList<Food> to add those four objects of Food, and then show the information of them together by traversing the ArrayList<Food> we created.

The sample output would be as follows:



```
Seafood pizza: (11 Inches) 120.00 $
Beef pizza: (9 Inches) 100.00 $
Seafood fried Rice: (5 Inches) 40.00 $
Beef noodles: (6 Inches) 35.00 $
```