FALL SEM – (2020-21)

CSE2005

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LAB NO : 4

SLOT : L5

Develop a class hierarchy of shapes and write a program that computes the amount of paint needed to paint different objects. The hierarchy will consist of a parent class Shape with three derived classes - Sphere, Rectangle, and Cylinder. For the purposes of this exercise, the only attribute a shape will have is a name and the method of interest will be one that computes the area of the shape (surface area in the case of three-dimensional shapes). Do the following.

1. Write an abstract class Shape with the following properties:
_ An instance variable shapeName of type String
_ An abstract method area()
_ A toString method that returns the name of the shape

2. The file *Sphere.java* contains a class for a sphere which is a descendant of Shape. A sphere has a radius and its area (surface area) is given by the formula 4*PI*radius^2. Define similar classes for a rectangle and a cylinder. Both the Rectangle class and the Cylinder class are descendants of the Shape class. A rectangle is defined by its length and width and its area is length times width. A cylinder is defined by a radius and height and its area (surface area) is PI*radius^2*height. Define the toString method in a way similar to that for the Sphere class.

3. The file *Paint.java* contains a class for a type of paint (which has a "coverage" and a method to compute the amount of paint needed to paint a shape). Correct the return statement in the amount method so the correct amount will be returned. Use the fact that the amount of paint needed is the area of the shape divided by the coverage for the paint. (NOTE: Leave the print statement - it is there for illustration purposes, so you can see the method operating on different types of Shape objects.)

4. The file *PaintThings.java* contains a program that computes the amount of paint needed to paint various shapes. A paint object has been instantiated. Add the following to complete the program:
_ Instantiate the three shape objects: deck to be a 20 by 35 foot rectangle, bigBall to be a sphere of radius 15, and tank to be a cylinder of radius 10 and height 30.
_ Make the appropriate method calls to assign the correct values to the three amount variables.
_ Run the program and test it. You should see polymorphism in action as the amount method computes the amount of paint for various shapes.

CODE:

```java
import java.util.*;
import java.lang.Math;
abstract class Shape{
        public String shapeName;
        abstract double area();
        public String toString(){
          return shapeName;
        }
}
class Sphere extends Shape{
      public double radius;
      Sphere(double r){
        super.shapeName = "Sphere";
        radius = r;
      }
      public double area(){
        return 4*Math.PI*radius*radius;
      }
      public String toString(){
        return super.shapeName;
      }
}
class Rectangle extends Shape{
  public double length;
  public double width;
  Rectangle(double l, double w){
    super.shapeName ="Rectangle";
    length =l;
    width = w;
  }
  public double area(){
    return length * width;
  }
  public String toString(){
    return super.shapeName;
  }
}
class Cylinder extends Shape{
  public double rad;
  public double height;
  Cylinder(double R,double H){
    super.shapeName = "Cylinder";
    rad =R;
    height = H;
  }
  public double area(){
```

```java
        return Math.PI*rad*rad*height;
    }
    public String toString(){
        return super.shapeName;
    }
}
class Paint{
    double coverage;
    Shape a;
    Paint(Shape user,double c){
        a = user;
        coverage = c;
    }
    public double amount(){
        double paintRequired = a.area()/coverage;
        System.out.println("The amount of paint needed for"+ " "+a.toString()+" "+
"is"+" " +paintRequired);
        return paintRequired;
    }
}
public class Main {
    public static void main(String[] args) {
    Scanner scan = new Scanner(System.in);
        System.out.println("Length of the deck : ");
        double LENGTH = scan. nextDouble();
        System.out.println("Width of the deck : ");
        double WIDTH = scan.nextDouble();
        System.out.println("Radius of the bigBall : ");
        double C_RADIUS = scan.nextDouble();
        System.out.println("Radius of the tank : ");
        double CY_RADIUS = scan.nextDouble();
        System.out.println("Height of the tank : ");
        double HEIGHT = scan.nextDouble();
        Rectangle deck = new Rectangle(LENGTH,WIDTH);
        Sphere bigBall = new Sphere(C_RADIUS);
        Cylinder tank = new Cylinder(CY_RADIUS, HEIGHT);
         Paint paint = new Paint(deck,15);
         paint.amount();
         paint = new Paint(bigBall,20);
         paint.amount();
         paint = new Paint(tank,10);
         paint.amount();
         scan.close();
    }
}
```

OUTPUT:

```
> javac -classpath .:/run_dir/junit-4.12.jar:target/dependency/* -d . Ma
in.java
> java -classpath .:/run_dir/junit-4.12.jar:target/dependency/* Main
Length of the deck :
20
Width of the deck :
35
Radius of the bigBall :
15
Radius of the tank :
10
Height of the tank :
30
The amount of paint needed for Rectangle is 46.666666666666664
The amount of paint needed for Sphere is 141.3716694115407
The amount of paint needed for Cylinder is 942.4777960769379
>
```